APPENDIX A

Well Installation and Maintenance Plan

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A	amperage
bgs	below ground surface
CA DWR	California Department of Water Resources
DO	dissolved oxygen
DOT	Department of Transportation
gpm	gallons per minute
I.D.	inside diameter
IDW	investigative-derived waste
JPL	Jet Propulsion Laboratory
mV	millivolts
NASA	National Aeronautics and Space Administration
NFESC	Navy Facilities Engineering Service Center
O.D.	outside diameter
ORP	oxidation reduction potential
POC	point of contact
PVC	polyvinyl chloride
TDH	total dynamic head
TDS	total dissolved solids
USCS	Unified Soil Classification System
U.S. EPA	United States Environmental Protection Agency
V	voltage
VOC	volatile organic compound

1.0 WELL INSTALLATION

1.1 Drilling Method

Each extraction/injection monitoring well will be drilled to the required depth below ground surface (bgs) using a 12.25-inch outside diameter (O.D.) mud-rotary drilling bit. This diameter of borehole is sufficient to place the well construction materials (i.e., 6.625-inch or 8.625-inch O.D. casing and screen) and allow for an appropriate filter pack and sealing materials which should be a minimum of 2 inches in thickness between the casing/screen and borehole wall. Approximately 20 ft of steel conductor casing will be set at the surface of each borehole to maintain the near surface integrity. The conductor casing will be removed after the well is constructed and all backfill materials have been placed. During drilling and well construction, drill cuttings will be separated from the drilling mud using a mud shaker. The separated mud is recycled into the drilling process and the cuttings are stored in a roll-off bin. Additional details regarding containerization and disposal of investigative-derived waste (IDW) are provided in Section 1.3.6.

All drilling equipment and materials, including drilling bits and pipes, drilling mud, and backfill materials, will be either new or cleaned in the field using a high pressure steam cleaner. Clean water supplied from a nearby clean water source (e.g., water spigot) will be used during drilling and well construction activities. During drilling, grab soil samples will be collected from the mud shaker for lithologic logging purposes and then disposed of with the soil cuttings. Soil samples will be logged using the Unified Soil Classification System (USCS). Soil boring logs will be incorporated into a bound field notebook. The field notebook will be used to document all sampling activities. These notebooks will be maintained as permanent records. An attempt will be made during the drilling process to collect one saturated and one unsaturated soil sample from each boring for use in determining selected physical parameters, such as hydraulic conductivity, porosity, and bulk density, as well as chemical analysis for perchlorate and volatile organic compounds (VOCs) by United States Environmental Protection Agency (U.S. EPA) Methods 314.0 and 8260B, respectively. All samples will be analyzed by a California-certified and Navy Facilities Engineering Service Center (NFESC) approved laboratory. In order to collect these samples, the downhole drilling equipment will be tripped so that soil sampling equipment can be inserted down the well for sample collection. An 18-inch long, 2-inch or 2.5-inch inside diameter (I.D.) split-spoon sampler attached to a 300-pound hammer will be used to collect undisturbed soil samples that will be used for analysis of physical and chemical parameters. The drilling and sampling methods described above are standard methods for installation of extraction and injection wells and collection of environmental soil samples in alluvial aquifers similar to the subsurface conditions present beneath the Jet Propulsion Laboratory (JPL) facility. Additionally, during well construction and development, the drilling mud will eventually be removed from the well.

Detailed descriptions of the mud rotary drill process and field documentation procedure are provided in National Aeronautic and Space Administration's (NASA) regulator approved *Work Plan for Performing a Remedial Investigation/Feasibility Study at NASA JPL* (Ebasco, 1993).

1.2 Geophysical Borehole Logging

The following sections provide details regarding geophysical logging methods that will be conducted in each borehole following the completion of well drilling activities. Upon completion of drilling and prior to the well installation, the borehole will be logged using geophysical methods to assist the field geologist with the identification of borehole lithologies, water-bearing intervals, and stratigraphic correlation with existing JPL monitoring and treatment system wells. Geophysical methods employed include: Gamma

Log, Caliper Log, Single-Point Resistance Log, and Spontaneous Potential Log. The purpose and use of these methods are provided in each of the respective subsections.

1.2.1 Gamma Log

This method records the amount of natural gamma radiation emitted by the rocks surrounding the borehole. Clay- and shale-bearing zones often emit relatively high gamma radiation because they contain weathering products that include uranium and thorium. Clay and shale layers are aquitards and it is important to identify their locations within the aquifer to optimize the extraction and injection of groundwater. This method is also useful to compare with the geologic log created during the drilling process.

1.2.2 Caliper Log

This method records borehole diameter. Changes in the borehole diameter are related to well construction, such as casing or drill-bit size, and to fracturing or caving along the borehole wall. Borehole diameter is useful in interpreting the other geophysical logs because it can affect the log response of the other methods. Caliper logs can detect poorly consolidated sands that tend to collapse in the borehole. These sands are generally very porous, water producing zones within the aquifer.

1.2.3 Single-Point Resistance Log

This method records the electrical resistance from points within the borehole to an electrical ground at the surface. Typically, resistance increases with increasing grain size and decreases with increasing borehole diameter, fracture density, and dissolved-solids concentrations of the water. Single-Point resistance logs require a fluid-filled borehole and are only run in the saturated zone of the aquifer. This method is useful in determining the location of water bearing zones because fluid-filled soil pores are less resistive than solid rock or low permeability soils (e.g. clays and silts). Identifying the water-bearing zones within the aquifer will be helpful in optimizing the well construction for more efficient groundwater extraction and injection. This method is also useful to correlate with the geologic log created during the drilling process.

1.2.4 Spontaneous Potential Log

This method records potentials or voltages developed between the borehole fluid and the surrounding formation material and fluids. Spontaneous potential logs can be used in the determination of porous and permeable beds within the aquifer. The spontaneous potential log are used in combination with single-point resistance logs to identify shales and sandstones (non-porous and porous, respectively) within the aquifer. This information is useful for identifying high water-bearing zones to optimize the extraction and injection of groundwater. This method is also useful to compare with the geologic log created during the drilling process.

1.3 Well Construction

Well construction will satisfy the requirements of the California Department of Water Resources (CA DWR), Water Well Standards, Bulletin 74-90, Supplement to Bulletin 74-81.

1.3.1 Well Casing Blank

The injection well casing will consist of 215 feet of 8.625-inch O.D., 7.625-inch I.D. Schedule (Sch) 80 polyvinyl chloride (PVC) casing. PVC casing is strong enough to resist collapse and is immune to electrolytic and galvanic corrosion that can occur with steel casing. It is resistant to biological growth and

is also chemically resistant to virtually all chemicals found in the groundwater beneath the JPL facility including the acids that are used during well rehabilitation.

Similar to the existing extraction wells, the new extraction well casing will consist of 215 feet of 6.625-inch O.D., 6-inch I.D. low carbon steel. Removal of chemical precipitates and biological growth (which have been identified in the existing OU-1 extraction wells) using chemical and physical cleaning methods can be accomplished with this casing material.

1.3.2 Well Screen

Well screens will consist of 100 feet of 10-foot long, 8.625-inch and 6.625-inch O.D., stainless steel wire wrap screens for the injection and extraction wells, respectively. The screen slot size has been chosen to retain approximately 90% of the filter pack material after well development. The injection well screen will have 0.050-inch slots while the extraction well will have 0.040-inch slots. The slot size for each type of well was chosen to facilitate the flows necessary to operate the OU-1 treatment system. Another factor selecting the slot size is analysis of drill cutting samples of the zone to be screened. Based on past drilling activities at JPL and the surrounding area, the lithology generally consists of silty to gravelly sands. Stainless steel screens best meet the characteristics of having a large percentage of non-clogging slots, are resistant to corrosion, have sufficient strength to prevent collapse, are easily developed, and prevent sand production during pump.

1.3.3 Well Sump

The well sump will consist of a 10-foot long section of the casing material, placed at the bottom of the well as a sediment collection point. The well sump for the injection well will consist of 7.625-inch I.D. Sch 80 PVC casing. The well sump for the extraction well will consist of 6-inch I.D. low carbon steel casing.

1.3.4 Filter Pack

Filter-pack size is determined by evaluating the size of the surrounding aquifer material, the function of the well (e.g. injection or extraction), and the well screen slot size. In general, the size of the filter pack material should be large enough for adequate volumes of water to pass through, but small enough to retain the aquifer material and minimize sediment production within the well. Filter pack material (e.g. sand) is sized according to how it falls through a wire mesh, or sieve.

The filter pack in extraction wells will consist of #8 mesh sand. The sand will be uniform in size and slightly larger than the slots in the well screen. This will allow fine-grained material to be removed during well development without entering the well and decreasing its effectiveness.

The filter pack in injection wells will consist of medium aquarium gravel. This gravel is large enough to not pass through the injection well screen and provides ample permeability for the injected treated water to move quickly into the aquifer.

In order to minimize bentonite sealing materials from permeating into the filter pack and potentially impacting the effectiveness of the well screen, the filter pack material will extend a minimum of 10-ft above the screen zone. The filter pack will be emplaced from the surface using the tremie method.

1.3.5 Seal

A 5-ft thick transition seal consisting of ¼-inch, time release coated bentonite pellets will be added on top of the filter pack. The purpose of the transition seal is to prevent the annular seal (e.g. liquid bentonite grout) from entering the filter pack. After the transition seal is in place, the annular seal will be installed. The purpose of the annular seal is to eliminate the formation of a pathway between the screened zone and potential contamination from the surface and overlying materials. The annular seal will be placed into the annular space above the transition seal to approximately the ground surface. The top of the well casing will be secured with a well head completed using a flush-mount H-20 rated single door steel well vault. Sealing materials will be emplaced from the surface using the tremie method.

1.3.6 Waste (Sediment and Drilling Mud)

All drill cuttings and drilling mud removed from individual boreholes will be placed directly into soil bins. The containers will be temporarily stored on site and labeled with the following information: date, project name and number, generator name, point of contact (POC), applicable contact numbers, contents of container, and the well identification number. The method of disposal will be determined based on the analytical results from soil samples collected from the respective containers. As required at the JPL facility the following analysis will be ran on all samples prior to disposal: VOCs, SVOCs, Title 26 Metals plus strontium, Cyanide, Hexavalent Chromium, Total Petroleum Hydrocarbons and Perchlorate

2.1 Well Development

After drilling a borehole and installing a well, it is necessary to remove the residual drilling fluid that forms a thin layer of mud on the sand grains of the borehole wall and filter pack material and is forced into the pore spaces and cracks in the aquifer. This plugging effect decreases the flow of water into or out of the well. This process is referred to as well development. Additionally, well development physically commingles the sorted gravel pack with the native formation, creating a hydraulic filter around the well screen which allows efficient passage of water into or out of the well. In general, the order of the development process for extraction and injection wells at JPL is as follows:

- Primary bail
- Brush
- Secondary bail
- Mud dispersant
- Dual-swab airlifting
- Mud dispersant
- Dual-swab airlifting
- Conventional surge pumping
- Injection development (injection well only).

Table 1 provides a description of the steps involved during initial well development. The remainder of this section provides a brief discussion of each of the above well development techniques.

Table 1. Well Development

Task	Description	Time
Primary Bailing	Bail solids from bottom of well with suction bailer.	2-3 hours
Brushing	Brush well from top to bottom in 20 foot intervals for 20 minutes each.	100 foot screen should be brushed for 100 minutes.
Secondary Bailing	Bail solids from bottom of well with suction bailer.	2-3 hours
Mud Dispersant	Mud dispersant treatment added to well. Dual-swab tool raised and lowered in well to agitate and mix dispersant distributing treatment into filter pack and borehole.	2 hours adding treatment to well. Well swabbed every two hours up to 24 hours; followed by removal.
Dual-Swab Airlifting	Swabbing, surging, and airlifting (75-175 gpm) of screened zone at select 10 foot intervals.	Pumping will occur at top of screened zone for 40 minutes (or until turbidity is ≤ 5 NTU) at a maximum pumping rate (between 75 – 175 gpm). The dual-swab airlift equipment will be raised and lowered throughout the screened zone. During airlifting the air supply will be shut off to surge the screen.
Bailing	Bail solids from bottom of well with suction bailer.	2-3 hours
Mud Dispersant	Mud dispersant treatment added to well. Dual-swab tool raised and lowered in well to agitate and mix dispersant distributing treatment into filter pack and borehole.	2 hours adding treatment to well. 12 hours of swabbing; followed by removal.
Dual-Swab Airlifting	Swabbing, surging, and airlifting (75-175 gpm) of screened zone at select 10 foot intervals.	Pumping will occur at top of screened zone for 40 minutes (or until turbidity is ≤ 5 NTU) at a maximum pumping rate (between 75 – 175 gpm). The dual-swab airlift equipment will be raised and lowered throughout the screened zone. During airlifting the air supply will be shut off to surge the screen.
Bailing	Bail solids from bottom of well with suction bailer.	2-3 hours
Conventional Pumping	Submersible pump is lowered into well and saturated zone is overpumped and surged.	Pump set at 300' and pump at max. rate achieved during airlift (i.e. 175 gpm) for 45 minutes
		Surge three times
		Pumping at 300'; pumping rate increased by 50 gpm to 225 gpm for 45 minutes
		Surge three times
		Pumping at 300'; pumping rate increased by 50 gpm to 275 gpm for 45 minutes
		Surge three times
		Pumping at 300'; pumping rate increased by 25 gpm to 300 gpm for 45 minutes
		Surge three times
Injection Development	Water is injected from a fire hydrant (or other source) and then pumped with a submersible pump until the turbidity is below 5 NTU	30 minutes of injection (from fire hydrant or other source capable of 200 gpm) and then pump for 40 minutes at 200 gpm
		30 minutes of injection (from fire hydrant or other source capable of 200 gpm) and then pump for 40 minutes at 200 gpm
		30 minutes of injection (from fire hydrant or other source capable of 200 gpm) and then pump for 40 minutes at 200 gpm
		Stop when turbidity < 5 NTU
Injection Testing	Step injection test; water is pumped into the aquifer for up to 10 hours, and water levels are monitored in injection and nearby wells. The pumping rate is tested at 75 gpm, 150 gpm, and the maximum injection rate, respectively, until the water level change is less than ± 1.0 feet or ± 2.31 psi.	Injection at 75 gpm
		Injection at 150 gpm
		Injection at maximum injection rate

2.1.1 Primary Bail

During this process, a suction bailer is lowered into the well until it fills with water and sediment. It is then pulled to the surface and emptied. The bailer's up and down motion causes a surging action which will initiate development in the area around the screen. As a result of the surging action and mud removal, water from the aquifer will then flow towards the well and bring in more drilling fluid. This process is continued until the majority of the drilling mud is removed from inside the well.

2.1.2 Brush

Brushing simply involves running a hard bristle brush up and down the length of the well screen to remove fines and sediment encrusted on the well casing and screen. Similar to bailing, the up and down movement of the brush produces a surging effect, continuing the development process. The diameter of the brush is slightly larger than the I.D. of the well, and should be made of a hard plastic or other material that will not abrade, gouge, or otherwise damage the casing or screen of the well. Brushing the well begins at the top of the well screen and moves toward the bottom of the well in 20-foot intervals. Each 20-foot interval is brushed for 20 minutes before moving on to the next interval. Upon completion of brushing, the total depth of the well is measured to determine how much sediment has accumulated as the result of the brushing activity. Any sediment that has accumulated at the bottom of the well is removed with a bailer.

2.1.3 Secondary Bail

After brushing, the suction bailer is lowered into the well to remove fines and sediment that have accumulated as a result of brushing.

2.1.4 Mud Dispersant

Following the completion of bailing, the majority of the drilling mud has been removed from inside the well. Next, a concentrated liquid polymer dispersant is applied to the well to facilitate removal of the residual mud and clay material present beyond the well screen and into the filter pack. The dispersant will be applied following the manufacturer's recommendations. The following is an example of the mixture calculation for the mud dispersant previously used during development of the existing OU-1 injection wells (i.e., Aqua-clear™ PFD):

Aqua-clear™ PFD (gal or L) = 0.002 × Borehole Water Volume (gal or L)

Therefore, 1 Gal Aqua-clear™ PFD should be mixed with 500 gals of water.

The mud dispersant will be mixed at the surface in a clean, graduated poly tank. Once the mixture has been thoroughly blended, it will be applied to the screened zone via a tremie pipe. To improve the effectiveness of the mud dispersant treatment, the well will be swabbed with a dual-swab every two hours for up to 24 hours (note: the available product information does not recommend letting the mixture sit overnight). The swabbing action ensures the distribution of the chemical treatment through the screened zone and filter-pack. After completing swabbing, the well will be tagged to calculate the amount of material that has accumulated in the bottom of the well.

The bottom of the well will then be bailed with a suction bailer to remove any sediment which may have accumulated. The solids will be placed into a 55 gallon drum, and the water will be temporarily stored in appropriate waste containers. Following the completion of swabbing and bailing, the residual mud and dispersant will be removed from the well using the dual-swab airlifting tool or similar pumping tool. A

second mud dispersant treatment followed by dual-swab airlifting will be conducted immediately after the first treatment. Additional details regarding the dual-swab airlifting process are provided below.

2.1.5 Dual-Swab Airlifting

The dual-swab airlifting method helps to concentrate the surging action of the swab, and pumping brings loosened material out of the well instead of merely washing it back into the filter pack on the down stroke (Smith, 1995). The tool used for this method consists of a 1-inch airline inside of a 4-inch eductor pipe attached to an open center double surge block. The double surge block will consist of two surge tools connected to each other by a 10-foot long, 4-inch diameter slotted pipe. The educator fitting is installed above the surge blocks inside the pipe. Through the airline, air is pumped down inside the eductor pipe from the surface and past the mouth of the educator pipe causing a vacuum in the surge zone which allows water and solids to be brought to the surface. This method involves moving the dual-swab tool up and down within the well over an approximately 10-15 foot interval while simultaneously pumping the well.

This pumping method requires adequate submergence of the airline to effectively lift the water to the surface for discharge. The pumping rate is dependant on the percent submergence of the airline below the water level present during pumping. For example, using the equipment listed above, at 80% submergence (i.e., casing water level of approximately 43 ft bgs in the OU-1 injection wells) a pumping capacity of 175 gallons per minute (gpm) could be achieved. The average water level observed in the OU-1 source area is approximately 200 ft bgs. In order to achieve pumping rates between 75 and 175 gpm at the shallowest screen level (i.e., 215 ft bgs) in the OU-1 injection wells, pump submergence between 40% to 80% would be required. This approach assumes casing water levels of between 129 to 43 ft bgs, respectively. During past attempts to artificially recharge the existing OU-1 injection wells while performing dual-swab airlifting, injection from the OU-1 treatment system was unsuccessfully attempted due to the low flow rates caused by the lack of equipment to direct the injection water down the casing while performing this development technique. Therefore, during future dual-swab airlifting, a well-head adaptor consisting of an appropriately sized T-sweep will be used to connect the injection line to the well-head. Using this equipment, the injection water will be directed into the casing while the dual-swab airlift tool is inserted through the top of the adapter. To the extent possible, water from the OU-1 treatment plant will be injected into the well in an attempt to create an artificial head (i.e. artificially raising the water level in the well through injection). System flow meters will be used to quantify and regulate flow into the well casing. Using water level measurements taken from inside the well, the flow control valve will be slowly opened until the maximum submergence (i.e., 80%) of the airline is achieved or the flow control valve is fully open.

The dual-swab tool will be inserted into the well and set at the top 10 feet of the screened zone (i.e., 215 – 225 ft bgs). Airlift pumping will occur at the maximum rate possible for a period of approximately 40 minutes or until the turbidity of the purge water is less than ≤ 5 NTU. Due to the turbidity of the airlifted water, the initial water will be pumped into a settlement tank before transferring to a containment tank. The dual-swab airlift equipment will be raised and lowered throughout the screened zone. During the airlift pumping, the air supply will be periodically shut off allowing the water column to flow back through the screen. The combination of swabbing, pumping and surging enhances the removal of trapped material in the screened zone and filter-pack.

Upon completion of dual-swab airlifting, a second mud dispersant treatment/dual-swab airlifting process may follow.

2.1.6 Conventional Surge Pumping

Conventional pump development involves pumping and surging the wells at a variety of rates until no further sand, turbidity, and drawdown declines are observed. Surge pumping will be attempted at up to 1.5 times the design capacity of the injection or extraction well. Therefore, the injection and extraction wells will be pumped at a rate of 300 gpm.

Conventional surge pumping will involve inserting a submersible pump (performance ≥300 gpm; without a back-flow preventer) into the well and set near the bottom of the screened interval. Pumping will begin at a rate at or near the pumping rate achieved during dual-swab airlifting. Throughout this process, starting with the initial pumping and each increase in pumping rate, the pump will be shut-off and the water in the discharge line allowed to drain back into the well and formation creating a surging effect.

Pumping and back-flushing will be repeated with incremental pumping rate increases of 75 gpm, until the maximum pumping rate of 300 gpm is achieved. Each pumping cycle will include back-flushing three times followed by continuous pumping for approximately 45 minutes. An in-line totalizer gauge will be used to measure the total purge water removed from the well.

While pumping, water quality parameters, including pH, conductivity, oxidation-reduction potential (ORP), temperature, dissolved oxygen (DO), and turbidity will be collected at least once every half hour and noted in the field book. Pumping will continue at 300 gpm until the water is observed by the field personnel to be clear and free of debris. At this point, parameter readings will be collected every three minutes using a handheld field meter and a flow through cell. Pumping will continue until the parameters stabilize (i.e. three successive readings within ±0.2 for pH, ±5% for conductivity, ±20 millivolts (mV) for ORP, ±3% for temperature, ±0.2 mg/L for DO, and ±10% for turbidity [should be ≤5 NTU)]). Upon parameter stabilization, development of the extraction well will be considered complete.

Turbid water produced during this process will be pumped into an intermediate tank for sediment settling, before being pumped into an open topped water storage tank. The open topped water tank is important to facilitate easy cleaning of the tank before being returned to the tank vendor.

2.1.7 Injection Development (Injection Well Only)

Due to the specialized use of the injection well, one additional development step will be completed. This step involves injection of water at a rate at or above the design injection rate (e.g. 200 gpm maximum) followed by pumping. During injection development, the well is continually clogged through injection, then unclogged through pumping, removing the mobile material that moved during the injection. The gravel-pack and formation are re-packed to withstand forces away from the well bore (injection).

Injection development will be attempted by using an isolation pump tool consisting of a pump located in the pipeline between a dual-swab packer assembly. The dual-swab packers will be connected to a 3-inch diameter injection/extraction pipe attached to a nearby fire hydrant or the OU-1 injection pipeline, if available. Using this equipment, water will be injected from the surface and recovered utilizing the down well pump. Injection intervals up to 30 minutes followed by pumping intervals up to 40 minutes will be attempted until turbidity readings of ≤5 NTU are achieved. In an attempt to assess the maximum injection capacity of the well, an injection flow control valve will be set at the maximum discharge rate and groundwater levels will be monitored and recorded. Injection rates will be monitored using a flow meter attached inline from the water source.

2.1.8 Waste (Development Purge Water and Sediment)

When developing a well that has been drilled using the mud rotary process, the drilling mud is removed from the borehole prior to removing the drilling equipment from the borehole. However, residual drilling mud can remain in the borehole and the formation. During the initial development process at other wells at the JPL facility, it was noticed that the purge water was highly turbid. Therefore, it is crucial to allow the sediment to settle out of the initial purge water in an open-top container. After the sediment has sufficient time to settle to the bottom of the container, the clear water will then be decanted into a second container for holding prior to final disposition. This process will be employed during the initial development of the wells at the JPL facility.

Sediment (e.g., sand, silt, clay, etc.) that has been removed during bailing and airlifting activities will be placed directly into 55-gallon Department of Transportation (DOT) approved steel drums. The containers will be labeled as stated in Section 1.3.6 above. The drums will be temporarily stored at the JPL facility pending disposal classification. The method of disposal will be determined based on the analytical results from soil samples collected from the respective boreholes during drilling and well installation activities.

Clear water and water that has been treated with Aqua-clear™ PFD has been successfully processed by the water treatment system in the past and will be processed in the same manner in future well development or rehabilitation activities.

2.2 Injection Testing

At the completion of the development, the injection well will be tested to develop an operational baseline for future performance tracking and maintenance. Data collected during this test will be used to measure the hydraulic response to injection cycles. A step injection well test will be conducted to estimate the maximum injection capacity of the well and the response of the aquifer system to the stresses during injection. The maximum injection test pumping rate is dependent upon the capacity of the OU-1 treatment system. Depending on the injection capacity of the well, the injection test may be conducted under pressurized conditions. During the test, the initial injection rate will be set at 150 gpm. Once the groundwater level in the injection well has stabilized, the injection rate will be incrementally increased, potentially up to the maximum injection rate or up to the capacity of the system, whichever is achieved first.

During the injection test, flow rates will be recorded every 10 minutes using an in-line flow totalizer. Groundwater levels will be recorded with a pressure transducer placed in the well and in the two closest standpipe groundwater monitoring wells. The pressure transducers will be programmed to take incremental readings throughout the entire testing procedure. This data will be used to create a water level rise curve that demonstrates the mounding of the groundwater in the vicinity of the injection well.

2.3 Inorganic and Organic Analyses

Following the completion of well development, groundwater samples will be collected from the discharge pipeline for inorganic and organic analysis. Results of these analyses are used to determine the clogging potential, encrustation or corrosion potential, and identify the types of organisms that are present in the groundwater that may lead to biofouling. These data will be used to define the baseline conditions in the aquifer and subsequent analyses will be used to evaluate the presence of biofouling, establish trends associated with changes in the groundwater over time, and provide useful information relating to well maintenance and rehabilitation requirements (e.g., chemical treatments).

The physicochemical (inorganic) data analyses include Phenolphthalein Alkalinity (Standard Method (SM) 2320), pH (SM 4500-H^+), Chlorides (SM 4500-Cl^-), Total Dissolved Solids (TDS), Total Hardness (SM 2340/EDTA), Carbonate Hardness (Calculated), Non-carbonate Hardness (Calculated), Calcium (SM 3500-Ca), Magnesium (SM 3500-Mg), Phosphate (SM 3500-P), Iron (SM 3500-Fe), Copper (SM 3500-Cu), Nitrate (SM 3500-NO_3^-), Tannin/Lignin (SM 5550), Sulfate (SM 4500-SO_4^{2-}), Silica as SiO_2 (SM 4500-SiO_2), Manganese (SM 3500-Mn), Saturation Index, and Redox Potential (SM 2580). Descriptions of the physicochemical analytical methods are provided in Table 2.

The biological assay analyses will include assessment of the total bacterial count per milliliter (SM 9211/Bioluminescence Test), the anaerobic bacterial load on the system (SM Modified 9221B), the presence of sulfur reducing bacteria (SM 9240D/9221C), the presence of iron oxidizing bacteria, branching or filamentous bacteria, protozoans (SM 9215 D, SM Modified 9221B, SM 9211/Bio-luminescence Test), and the identification of the two largest populations of bacteria present (Method Biolog Microlog System). These data will be used to determine the types of organisms that are present in the well as a baseline for later biofouling evaluation.

Table 2. Summary of Physicochemical Methods Relevant to Well Maintenance

Constituent Analysis	Purpose of Analysis
Fe (total, Fe^{2+}/Fe^{3+}, Fe minerals and complexes)	Indications of clogging potential, presence of biofouling, Eh shifts. Fe transformations are the most common among redox-sensitive metals in the environment
Mn (total, Mn^{4+}/Mn^{2+}, minerals and complexes)	Indications of clogging potential, presence of biofouling, Eh shifts. Less common but locally important in some wellfields.
S (total, $S^{2-}/S^0/SO_4^{2-}$, S minerals and complexes)	Indications of corrosion and clogging potential, presence of biofouling, Eh shifts.
Eh (redox potential)	Direct indication of probable metallic ion states, microbial activity. Usually bulk Eh, which is a composite of microenvironments.
pH	Indication of acidity/basicity and likelihood of corrosion and/or mineral encrustation. Combined with Eh to determine likely metallic mineral states present.
Conductivity	Indication of TDS content and a component of corrosivity assessment.
Major ions	Carbonate minerals, F, Ca, Mg, Na, and Cl determine the types of encrusting minerals that may be present and are used in saturation indices. One surrogate for many cations in total hardness.
Turbidity	Indication of suspended particles content, suitable for assessment of relative changes indicating changes in particle pumping or biofouling.
Sand/silt content (v/v, w/v)	Indication of success of development/redevelopment, potential for abrasion and clogging.

Note: Generally, the Fe^{2+}/Fe^{3+} ratio (easily measured using conventional field analysis instruments) is the most useful. In some settings, Mn oxidation (resulting in more difficult-to-remove minerals) and the sulfur system may be dominant.
U.S. Army Corps of Engineers, 2000

2.4 Video Survey

Upon completion of well development and during each well maintenance event, a video survey will be completed in the wells to confirm the "as-built" construction of the well, to inspect for any damage (i.e., casing breaks, holes, etc.), examine the screened zone to ensure the well has been properly developed, and assess the well for potential fouling elements (e.g., biological growth, mineralization, and sedimentation). During a down-hole video survey, a camera is lowered into the well and the image is observed on a video

monitor and simultaneously recorded on a VHS tape (which can be transferred to a DVD once the log is complete). The depth of the camera is superimposed onto the video image and is also recorded. Once the log is completed, three hardcopy reports (including photos), and three color video log (VHS and DVD) copies will be obtained and stored onsite.

2.5 Spinner Log

Spinner probes are commonly used in water-producing wells to measure well hydraulics (i.e., water flow patterns). A static spinner log is conducted with the well pump equipment turned off while the groundwater is under static conditions. Conversely, a dynamic spinner log is completed while the well pump is operating under normal conditions. The flow log reveals zones where water enters and exits the well screen and allows for flow contributions from individual zones to be measured and documented. Spinner log data are correlated with geophysical log data (i.e., single-point resistance log) and the lithologic log from the well installation to evaluate flow conditions within the well during static and pumping (dynamic) conditions (extraction wells only). This information is then used to identify specific zones within a well that have higher flow potential.

A static spinner log will be completed in the injection well. Both a static and dynamic spinner log will be attempted in the extraction well. Based on the results of the spinner log analysis, depth discrete groundwater samples will be collected from high flow zones (if present) within the extraction well to create a baseline vertical contaminant profile. These data, combined with similar data collected in the future, can be utilized during system optimization evaluations for repositioning the extraction pumps to target zones that exhibit higher levels of site chemicals of concern. Because pumping equipment is not planned for the injection wells, dynamic spinner logging will not be conducted.

2.6 Well and Pump Performance Monitoring

Deteriorating conditions in wells can be complex and a result from a number of factors. The screens can become clogged with fine-grained sediment, air, mineral deposits, or biological/bacteria growth. The best way to combat these factors is to recognize them early and identify an appropriate and effective maintenance plan. Tests should be done to detect the electromechanical, physical, chemical, and microbial conditions within the well. Record-keeping of pumping and well service is also essential. Table 3 lists important information that should be collected during performance monitoring.

To facilitate the performance monitoring program for the OU-1 wells, background injection and extraction well data are critical. Therefore, the following records will be kept onsite and available for review for the preventive maintenance program:

- Physical locations and “as-built” descriptions of wells and equipment
- As-built diagram of the well’s construction, with any modifications over time
- Lithologic logs, well drilling and construction logs, and any other logging data (i.e. geophysical logs) applicable to the well drilling and design
- Development logs (to provide benchmark data), available laboratory analytical data collected during development
- Records of pumping/injection tests (aquifer and slug tests) and geophysical structure (i.e. spinner log)
- Dates of replacement of components, manufacturer and type of component
- Electrical, power and pump mechanical information

- Water quality data from wellhead samples, plus biofilm collector results, listed by date
- Details of well rehabilitation activities, including dates, diagnosis, if any, treatment methods, results, time involved, and costs
- Color borehole TV survey videotapes/DVDs.

In addition to the data listed above, the system operator will collect the following information and data in order to observe and track injection and extraction system performance and efficiency:

- Water levels will be manually collected with a water level probe weekly from the wells surrounding the extraction and injection wells
- Injection and extraction well water levels will be taken daily with pressure transducers and weekly readings will be collected manually
- System and motor electrical testing (i.e. circuit voltage [V], motor amperage [A], phase [Φ], and resistance ohms [Ω]). Meters will be installed and the data will be manually collected by the system operator
- Well head pressure readings (i.e. injection pressure)
- Injection and Extraction flow rates (daily and at any rate change)
- Inorganic and organic analyses will be conducted following development and rehabilitation. Inorganic analyses include alkalinity, pH, chlorides, total dissolved solids (TDS), total hardness, Ca, Mg, phosphate, Fe, Cu, nitrate, tannin/lignin, sulfate, Si, Mn, saturation index, and redox potential. Organic analyses include total bacteria per milliliter, anaerobic bacterial load on the system, the presence of sulfur and/or iron reducing bacteria, the presence of iron oxidizing bacteria, protozoans, and the identification of the two largest populations of bacteria.

Measuring water levels is important in determining well discharge or acceptance into the aquifer as well as monitoring mounding (injection wells), or drawdown (extraction wells). In addition, monitoring water levels/injection pressure in the injection wells can indicate clogging of the filter pack and screened zone.

Monitoring the system's electrical power is important to detect problems within the electrical system and prevent excessive motor aging, poor performance, and maintaining motor and system efficiency.

Monitoring well head pressure and injection/extraction flow rates can indicate well efficiency. Lower flow rates may be indicative of inefficient pump performance or screen and filter pack clogging. Table 4 provides a description of the causes of poor well performance.

Table 3. Performance Monitoring

Task	Description	Frequency	Records	What does data indicate?
Water Levels	Manual collection of water levels in wells surrounding injection and extraction wells.	Weekly	Field book	Determines well discharge or acceptance into the aquifer as well as mounding (injection wells), or drawdown (extraction wells).
Injection and Extraction Water Levels	Pressure transducer readings of water levels and wellhead pressure.	Daily	Field book	Water levels can also indicate clogging in the filter pack and screened zone.
Injection and Extraction Flow-rates	Automatic flow readings collected at system control panel.	Daily	Field book	Lower flow rates may indicate clogging or biofouling.
Inorganic and Organic Analyses	Laboratory data analyses of physicochemical and biological assay components of injection and extraction system water. The results indicate the correct treatment of the well during rehabilitation (i.e. chemical treatments).	Quarterly	Lab report	Physicochemical analyses indicate corrosion or encrustation potential (long-term tracking can show increases and decreases over time) and biological assay indicates biofouling, the types of organisms present, and long-term monitoring shows increases and decreases in biofouling.
Electrical	System and motor electrical testing (circuit voltage [V], motor amperage [A], phase [Φ], and resistance ohms [Ω]).	Daily readings	Field book	Detect problems within the electrical system and prevent excessive motor aging, poor performance, and maintaining motor and system efficiency.

Table 4. Definitions of Poor Well Performance and Causes

Problems	Causes
Sand/Silt Pumping: Pump and equipment wear and plugging.	Inadequate screen and filter-pack selection or installation, incomplete development, screen corrosion, collapse of filter pack due to washout resulting from excessive vertical velocity in the filter pack, presence of sand or silt in fractures intercepted by a well completed "open-hole," incomplete casing bottom seat (casing-screen break) or casing-screen break due to settlement, ground movement, or poor installation. Pumping in excess of gravel pack and system capacity (oversized pump, pipe breakage lowering pumping head, etc.).
Silt/Clay Infiltration: Filter clogging, sample turbidity.	Inadequate well casing seals, infiltration through filter pack, or "mud seams" in rock, inadequate development, or casing-screen break due to settlement, ground movement, or poor installation. Formation material may be so fine that engineered solutions are inadequate.
Pumping Water Level Decline: Reduced yields, increased oxidation, well interference, impaired pump performance.	Area or regional water-level declines, pumping in excess of sustainable well capacity, well interference, or well plugging or encrustation. Sometimes a regional decline will be exaggerated at a well due to plugging.
Injection water level rise and reduced acceptance rate or increased injection system head.	Area or regional water-level rise; injection in excess of sustainable well capacity; well plugging or encrustation; encrustation, plugging, or corrosion, and perforation of discharge lines; increased total dynamic head (TDH) in water delivery system.
Lower (or Insufficient) Yield: Unsatisfactory system performance.	Dewatering or caving in of a major water-bearing zone, pump wear or malfunction, encrustation, plugging, or corrosion and perforation of discharge lines, increased TDH in water delivery or treatment system.
Complete Loss of Production: Failure of system.	Most typically pump failure. Also loss of well production due to dewatering, plugging, or collapse.
Chemical Encrustation: Increased drawdown, reduced output or reduced injection acceptance rate.	Deposition of saturated dissolved solids, usually high Ca, Mg, carbonate, and sulfate salts or iron oxides, or FeII sulfides. May occur at chemical feed points, e.g., feeding caustic soda to raise pH into a Ca-rich water.
Biofouling Plugging: Increased drawdown, reduced output or reduced injection acceptance rate, alteration of samples, clogging of filters and lines.	Microbial oxidation and prescription of Fe, Mn, and S (sometimes other redox-changing metals that are low solubility when oxidized) with associated growth and slime production. Often associated with simultaneous chemical encrustation and corrosion. Associated with simultaneous chemical encrustation and corrosion. Associated problem: well "filter effect": samples and pumped water are not necessarily representative of the aquifer. Often works simultaneously with other problems such as silting.
Pump/Well Corrosion: Loss of performance, sanding, or turbidity.	Natural aggressive water quality, including H2S, NaCl-type waters, biofouling electrolysis due to stray currents. Aggravated by poor engineered material selection.
Well Structural Failure: Well loss and abandonment.	Tectonic ground shifting, ground subsidence, failure of unsupported casing in caves or unstable rock due to poor grout support, casing or screen corrosion and collapse, casing insufficient, local site operations.

U.S. Army Corps of Engineers, 2000

3.0 WELL REHABILITATION

When the performance monitoring data suggests decreases in injection or extraction well efficiency below the levels required to operate the OU-1 system, the well will require rehabilitation by chemical and/or mechanical means to return it to optimal flow rates. A brief summary of the steps involved during well rehabilitation are included in Table 5. The following sections provide descriptions and methods of well rehabilitation.

3.1 Equipment Removal and Inspection

The injection or extraction well should be shut-down a minimum of 24 hours prior to the removal of equipment in order to allow the well to return to a static condition. Power to the pumps should be secured using lock-out and tag-out procedure to prevent shock or electrocution. Injection well valves should be turned off to prevent water from leaking into the well vault. The electrical wires connecting the transducer or pump should be disconnected. The well head equipment will need to be disconnected from the well casing. Once completed, this equipment will be hoisted from the well using the development rig. Following removal, the field crew will document any discoloration on the piping, biological deposition or encrustation (i.e. slime), mineral growth and/or deterioration to the downwell equipment in the field notebook and take pictures as necessary. The removed equipment will be staged near the well site on plastic sheeting to minimize the potential for surface contamination.

3.2 Video Survey

A video log will be taken in order to determine the well condition. The extent of biofouling, sedimentation and encrustation will be documented. Notes will be taken including the depth to water, percentage of screen blockage (include depths, color and type of material), overall water quality, and damage to casing or screen. Section 2.4 provides a detailed description of the video survey process.

3.3 Inorganic and Organic Analysis

After the completion of the video log, physicochemical and biological assay data analyses will be collected. The results of these analyses will be compared to the baseline data that was collected during initial development of the well, and used to determine the nature of the problems and the counter-measures. Based on these data, rehabilitation and maintenance measures can be fine-tuned based on observed changes. Analytical methods used for these analyses are provided in Section 2.3.

The physicochemical (inorganic) data analyses include Phenolphthalein Alkalinity, pH, Chlorides, TDS, Total Hardness, Carbonate Hardness, Non-carbonate Hardness, Calcium, Magnesium, Phosphate, Iron, Copper, Nitrate, Tannin/Lignin, Sulfate, Silica as SiO_2, Manganese, Saturation Index, and Redox Potential. The Iron, Manganese, and Sulfur (total, Fe^{2+}/Fe^{3+}, Fe minerals and complexes, total, Mn^{4+}/Mn^{2+}, minerals and complexes, and total, $S^{2-}/S^{0}/SO_4^{2-}$, S minerals and complexes) are analyzed in order to predict the clogging potential, presence of biofouling, and redox potential shifts (Eh shifts). The analyses of pH indicate acidity or basicity which predicts corrosion or encrustation. In addition, pH is combined with Eh to determine the likely metallic mineral states present. Conductivity is used to indicate the total dissolved solids content and is a component of the corrosivity assessment.

The biological assay is used to determine the presence of biofouling, the types of organisms that are present, and if the well has increased or decreased in biofouling over time (based on long-term monitoring).

The biological assay analyses will include assessment of the total bacterial count per milliliter, the anaerobic bacterial load on the system, the presence of sulfur reducing bacteria, the presence of iron oxidizing bacteria, branching or filamentous bacteria, protozoans, and the identification of the two largest populations of bacteria present.

Groundwater samples will be collected from the injection water stream, screened zone (aquifer), and the extraction water stream prior to rehabilitation. The injection and extraction samples should be collected from the sampling ports, and the aquifer sample should be collected using a submersible pump. Biological assay samples do not require refrigeration if they are received by the laboratory within 24 hours of sampling. In addition, no preservatives are to be used in the sampling bottles.

3.4 Bailing

During this process, a suction bailer is lowered into the well until it fills with water and sediment. It is then pulled to the surface and emptied. Water from the aquifer will then flow towards the well and bring in more drilling fluid. The bailer's up and down motion causes a surging action which initiates development in the area around the screen.

Prior to initiating the bailing procedure, the water level, and total depth of well will be measured to the nearest 0.01 ft, noting the amount of sediment in the well (as compared to the total depth in the "as-built"). Next, the sediment will be removed from the bottom of the well using the suction bailer and the contents will be emptied into a 55 gallon drum. The color, clarity and smell of the water will be noted in the field notebook. After the sediment has been removed from the bottom of the well, the total well depth will be measured again. Throughout this process, purge water present in the 55-gallon drum will be decanted to a water storage container and the amount of material (i.e. sand/silt, etc.) present in the bottom of the drum will be noted (i.e., the amount of sediment removed from the well). The amount of accumulated sediment in the well should progressively decline following successive rehabilitation events. If similar increased sediment volumes are noted in a well during successive rehabilitation events, the OU-1 treatment system will be evaluated for debris discharge and/or more aggressive development methods will be considered.

3.5 Brushing

Brushing simply involves running a hard bristle brush up and down the length of the well screen to remove sediment encrusted on the well casing and screen. Similar to bailing, the up and down movement of the brush produces a surging effect, continuing the development process. Section 2.1.2 includes a detailed description of the brushing process.

3.6 Biofouling Treatment

Following the completion of brushing and bailing, a chemical solution is applied to the well to facilitate the breakdown of biofilm, and to disperse mineral salts that are present in the well screen and the filter pack. The chemical treatment will be applied following the manufacturer's recommendations.

To ensure the proper distribution of the chemical treatment in the screened zone, the treatment mixture will be tremied into the upper, middle, and bottom third of the well screen. To improve the effectiveness of the chemical treatment, the well will be swabbed every two hours. The agitation caused by swabbing ensures the distribution of the chemical treatment through the screened zone and filter-pack. The solution should remain in the well between 18 to 48 hours depending on the severity of the biofouling and/or encrustation. In addition, it's important that the pH of the treatment solution stay below 2.0. If the chemical mixture is left in the well overnight, a water and acid mixture should be added to the well to

ensure that the pH remains below 2.0. The following morning, the pH should be tested and, if it is greater than 2.0, it should be lowered with the acid and water mixture. After this has been completed, the well should be swabbed for at least one hour.

Next, an airlift pump system will be lowered into the bottom of the well to remove the chemicals, biofilm and mineral salts. During the airlift pumping process, the pH of the discharge water will be monitored, and the airlifting will continue until the pH of the discharge water is >5.

Upon completion of the airlifting, a second chemical treatment will be performed, as described in the section above.

3.7 Mud Dispersant

In contrast to initial well development, during well rehabilitation only one mud dispersant treatment will be performed (however, in some cases [e.g., excessive drilling mud present in the well] a second treatment will be necessary). In theory, the mud dispersant treatment will follow the completion of the initial rehabilitation steps of brushing, sediment removal, and biofouling treatment. In order for the mud dispersant to penetrate into the filter pack and beyond, fouling materials (i.e. biological growth, mineral encrustations, etc.) need to be removed and the available flow paths restored.

Section 2.1.4 provides a detailed discussion regarding the mud dispersant application and removal process.

3.8 Dual-Swab Airlift

During well rehabilitation, dual-swab airlifting will be utilized after the mud dispersant treatment application to remove accumulated sediment and groundwater containing the treatment chemicals. Groundwater containing the treatment chemicals will be removed to the extent practical to minimize potential impacts to the treatment system (e.g., downgradient extraction).

Initially, the dual-swab tool will be inserted into the well and set at the top 10 feet of the screened zone (i.e., 215 – 225 ft bgs). Airlift pumping will occur at the maximum rate possible for a period of approximately 40 minutes or until the turbidity of the purge water is less than ≤ 5 NTU. Due to the turbidity of the airlifted water, the initial water will be pumped into a settlement tank before being transferred to a containment tank. The dual-swab airlift equipment will be raised and lowered throughout the entire screened zone. During the airlift pumping, the air supply will be periodically shut off allowing the water column to flow back through the screen. The combination of swabbing, pumping and surging enhances the removal of trapped material in the screened zone and filter-pack.

Upon completion of dual-swab airlifting, a second mud dispersant treatment/dual-swab airlifting process may follow. Section 2.1.5 provides a detailed description of the equipment used during the dual-swab airlifting process.

3.9 Conventional Surge Pumping

This stage of rehabilitation involves pumping and surging the wells at a variety of rates until no further sand, turbidity, and drawdown declines are observed. Section 2.1.6 provides a detailed description of conventional pump development.

3.10 Equipment Re-installation

Using the development rig, the PVC casing (injection well) and steel casing and pump (extraction well) will be reset into the well. Once the equipment is lowered into place, the well head flange plates will be bolted, and associated piping reconnected to the injection or extraction line. The electrical wires connecting the transducer or pump should be re-connected, and tested. Finally the equipment should be leak tested and injection and extraction rates tested.

3.11 Waste (Rehabilitation Water and Sediment)

Purge water that is generated during the rehabilitation process will be highly turbid, and in some cases may contain acid or mud dispersant chemicals. Without treatment, water that has been treated with acid to remove biofouling and/or scaling is not compatible with the fluidized bed reactor water treatment system at OU-1. Therefore, prior to processing this water through the OU-1 treatment plant, the purge water will be stored in appropriate containers, sediment will be allowed to settle out, and the water will be neutralized (i.e., pH = 7). After the water is neutralized, it will process through the OU-1 treatment system and be reinjected into the aquifer.

Section 2.1.8 describes the procedure for dealing with the solid and liquid waste that is generated during the well development and well rehabilitation process.

3.12 Injection Testing

At the completion of the well rehabilitation, the injection well will be tested to determine the success of the rehabilitation procedure. Data collected during this test will be used to measure the hydraulic response to injection cycles. A detailed description of the procedure is described in Section 2.2.

Table 5. Well Rehabilitation

Task	Description	Time
Well Shutdown	Turn off well and associated valves 24 hours prior to equipment removal.	24 hours in advance.
Equipment Removal and Evaluation	Disconnect electrical equipment, disconnect well head plumbing, remove injection well piping or extraction well piping, and pull equipment from well. Note any discoloration, fouling, encrustation, and overall condition of equipment removed from the well.	½ day (4 hours)
Inorganic and Organic Analyses	Collection of water samples for inorganic and organic laboratory analyses.	2-3 hours
Video Log	Video log of well casing and screen to determine well conditions. Note clarity of water column, biofouling, encrustation, and percentage of screen clogging.	2-3 hours
Bailing	Bail solids from bottom of well with suction bailer.	2-3 hours
Brushing	Brush well from top to bottom in 20 foot intervals for 20 minutes each.	100 foot screen should be brushed for 100 minutes.
Bailing	Bail solids from bottom of well with suction bailer.	2-3 hours
Biofouling Chemical Treatment	Bioacid dispersant and acid treatment introduced to well screen and agitated.	18 – 48 hours
Airlifting	Swabbing, surging, and airlifting (75-175 gpm) near bottom of screened zone (e.g. 305' btoc) .	Pumping will occur at the bottom of the screened zone until the pH of the discharge water is ≥ 5.
Biofouling Chemical Treatment	Second bioacid dispersant and acid treatment introduced to well screen and agitated.	18 – 48 hours
Airlifting	Swabbing, surging, and airlifting (75-175 gpm) near bottom of screened zone (e.g. 305' btoc).	Pumping will occur at the bottom of the screened zone until the pH of the discharge water is ≥ 5.
Bailing	Bail solids from bottom of well with suction bailer.	2-3 hours
Mud Dispersant	Mud dispersant treatment added to well. Surge tool raised and lowered in well to agitate and mix dispersant distributing treatment into filter pack and borehole.	2 hours adding treatment to well. Well swabbed every two hours up to 24 hours; followed by removal.
Dual-Swab Airlifting	Swabbing, surging, and airlifting (75-175 gpm) of screened zone at select 10 foot intervals.	Pumping will occur at top of screened zone for 40 minutes (or until turbidity is ≤ 5 NTU) at a maximum pumping rate (between 75 – 175 gpm). The dual-swab airlift equipment will be raised and lowered throughout the screened zone. During airlifting the air supply will be shut off to surge the screen.
Bailing	Bail solids from bottom of well with suction bailer.	2-3 hours
Mud Dispersant and Dual-Swab Airlifting	Repeat two above steps (if necessary)	Same as above.

Table 5. Well Rehabilitation (continued)

Task	Description	Time
Conventional Pumping	Submersible pump is lowered into well and saturated zone is overpumped and surged.	Pump set at 300' and pump at max. rate achieved during airlift (i.e. 175 gpm) for 45 minutes
		Surge three times
		Pumping at 300'; pumping rate increased by 50 gpm to 225 gpm for 45 minutes
		Surge three times
		Pumping at 300'; pumping rate increased by 50 gpm to 275 gpm for 45 minutes
		Surge three times
		Pumping at 300'; pumping rate increased by 25 gpm to 300 gpm for 45 minutes
		Surge three times
Equipment Re-installation	Equipment is re-installed into well, and well is performance tested.	4 – 6 hours
Injection Testing	Step injection test; water is pumped into the aquifer for up to 10 hours, and water levels are monitored in injection and nearby wells. The pumping rate is tested at 75 gpm, 150 gpm, and the maximum injection rate, respectively, until the water level change is less than ± 1.0 feet or ± 2.31 psi.	Injection at 75 gpm Injection at 150 gpm Injection at maximum injection rate

4.0 SELECTED REFERENCES

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Smith, S.A. 1995 "Monitoring and Remediation Wells: Problem Prevention, Maintenance, and Rehabilitation." Taylor & Francis, London.

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ATTACHMENT 1

PERFORMANCE LOG

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JPL
Source Area Demonstration Study Well
Performance Log

1. Electrical			
Date:	Time:		Comments
Circuit Voltage (V):	Phase (Φ):		
Amperage (A):	Resistance Ohms (Ω):		
2. Injection and Extraction Water Levels			
IW-1	**IW-2**	**IW-3**	Comments
Time:	Time:	Time:	
DTW:	DTW:	DTW:	
EW-1	**EW-2**	**EW-3**	Comments
Time:	Time:	Time:	
DTW:	DTW:	DTW:	
3. Injection and Extraction Flow Rates			
IW-1	**IW-2**	**IW-3**	Comments
Time:	Time:	Time:	
Flow Rate:	Flow Rate:	Flow Rate:	
EW-1	**EW-2**	**EW-3**	
Time:	Time:	Time:	
Flow Rate:	Flow Rate:	Flow Rate:	

Field Team Leader Signature_____

APPENDIX B

Sampling and Analysis Plan

This Sampling and Analysis Plan (SAP) describes requirements for the site remedial activities at the NASA JPL Facility.

Title of the Project: OU1 Remedial Design (RD)/Remedial Action (RA) Work Plan.

Organization Responsible for Implementing RD/RA Work Plan: Battelle

Effective Date of Plan: September 2006

Keith Fields
Battelle Project Manager

8/18/06
Date

Betsy Cutie
Battelle Project Quality Assurance Officer

8/18/06
Date

Steve Slaten
NASA Remedial Project Manager

Date

The following persons will be provided copies of the approved SAP and any subsequent revisions.

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AL	action level
amsl	above mean sea level
bgs	below ground surface
CFR	Code of Federal Regulations
CCL_4	carbon tetrachloride
ClO_4^-	perchlorate
CPR	cardiopulmonary resuscitation
DHS	Department of Health Services
DI	distilled
DO	dissolved oxygen
DOT	Department of Transportation
DQO	data quality objective
FBR	fluidized bed reactor
FEP	fluorinated ethylene polymer
FID	flame ionization detector
GAC	granulated activated carbon
HAZWOPER	Hazardous Waste Operations and Emergency Response
HCl	hydrochloric acid
HPLC	high-performance liquid chromatography
I.D.	inside diameter
IDW	investigation-derived waste
LCS	laboratory control spike(s)
LCSD	laboratory control spike duplicate(s)
LQAP	Laboratory Quality Assurance Plan
MCL	maximum contaminant level
MDL	method detection limit
MS	matrix spike(s)
MSD	matrix spike duplicate(s)
NA	not applicable
ND	not detected
NEDD	Navy Environmental Data Deliverable
NFESC	Naval Facilities Engineering Service Center
O_2	oxygen
O&M	operation and maintenance
ORP	oxidation-reduction potential
OSHA	Occupational Safety and Health Administration
PPE	personal protective equipment

QA	quality assurance
QAO	Quality Assurance Officer
QAPP	Quality Assurance Project Plan
QA/QC	quality assurance/quality control
QC	quality control
RA	remedial action
RD	remedial design
RPD	relative percent difference
RPM	Remedial Project Manager
RSD	relative standard deviation
SAP	Sampling and Analysis Plan
U.S. EPA	United States Environmental Protection Agency
VOA	volatile organic analysis
VOC	volatile organic compound

1.0 PROJECT MANAGEMENT

This Sampling and Analysis Plan (SAP) has been provided as Appendix C in the OU1 Remedial Design (RD)/Remedial Action (RA) Work Plan for the NASA JPL facility. The SAP serves two functions: (1) identifying the data to be collected and the methods of sample collection and analysis; and, (2) documenting how quality assurance (QA) and quality control (QC) activities will be implemented during the life cycle of the project to ensure that data are of sufficient quality for their intended purpose (i.e., to support decision making regarding remediation of the groundwater beneath NASA JPL). The SAP was prepared according to United States Environmental Protection Agency (U.S. EPA) Guidance (EPA QA/R-5; U.S. EPA, 2001) on preparation of Quality Assurance Project Plans (QAPPs); according to the U.S. EPA guidance, QAPPs are designed to be stand-alone documents that describe both field sampling activities as well as quality assurance/quality control (QA/QC) activities.

The information presented in this SAP is organized into four groups according to their function as follows:

A. Project Management – this group is divided into elements that describe general areas of project management, project history and objectives, and roles and responsibilities of the participants.

B. Data Generation and Acquisition – this group is divided into elements that describe the existing (Demonstration System) and proposed (Expanded Demonstration System) design, sampling and analytical methods, sample handling, and QC requirements.

C. Assessment and Oversight – this group is divided into elements that describe activities for assessing the effectiveness of sample collection and analysis and associated QA/QC requirements.

D. Data Validation and Usability – this group is divided into elements that describe QA activities that occur after the data generation and acquisition phase of the project has been completed to ensure that data conform to the specified criteria and thus are useful for their intended purpose.

1.1 Title and Approval Page (A1)

The NASA JPL SAP Project Title and Approval sheet is provided as page ii of the SAP.

1.2 Table of Contents (A2)

The NASA JPL SAP Table of Contents is presented beginning on page iv of the SAP.

1.3 Distribution List (A3)

The NASA JPL SAP Distribution List is presented on page iii of the SAP.

1.4 Project Organization and Responsibilities (A4)

Figure B-1 provides a project organization chart for RD/RA at the NASA JPL facility. Key personnel shown in the chart include the NASA Remedial Project Manager (RPM), NAVFAC Coordinator, JPL Point of Contact, Battelle Project Manager, Battelle Quality Assurance Officer (QAO), and the Battelle Project Team. Key subcontracted services are anticipated to include the following: analytical laboratories

for analysis of soil and water samples; driller for installation of wells and collection of soil samples; and surveyors for site layout. Key roles and responsibilities for technical staff associated with the work outlined in this SAP are presented in the Distribution List, which includes contact e-mail addresses and telephone numbers for staff members.

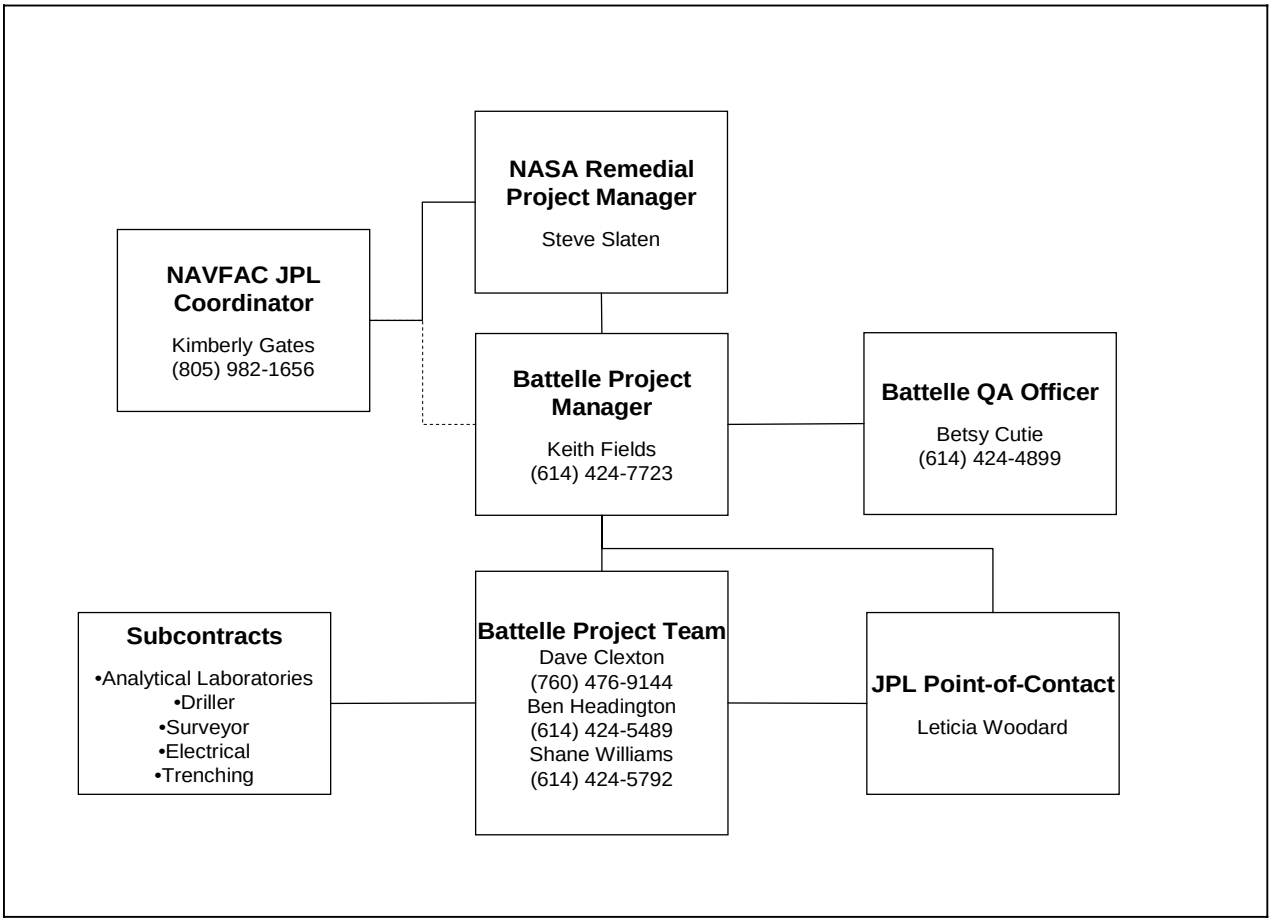

FIGURE B-1. PROJECT ORGANIZATION CHART FOR EXPANDED DEMONSTRATION SYSTEM INTERIM ACTION AT THE NASA JPL FACILITY

1.5 Problem Definition/Background (A5)

Perchlorate (ClO_4^-) and carbon tetrachloride (CCl_4), which are believed to be associated with historic waste management practices at NASA JPL, have been detected in water supply wells located downgradient of the NASA JPL facility. Significant dissolved phase concentrations of ClO_4^- and CCl_4 (greater than 100 times California Action Level [AL] and Maximum Contaminant Level [MCL], respectively) are located on the NASA JPL facility and likely serve as a continuing source. The presence of a continuing source is supported by elevated concentrations in the suspected release area over 40 years after the discharge(s) occurred. The highest dissolved phase concentrations of ClO_4^- and CCl_4 are collocated in the uppermost hydrostratigraphic layer near MW-7, MW-16, and MW-24.

The Expanded Demonstration System, interim action will extend the effectiveness of the expanded treatability study (Demonstration System) by broadening the treatment area in a westerly direction to

further target the suspected source area, which has been defined as an 8-acre by 100-ft-thick portion of the site, located in the north-central section of the NASA JPL facility. This source area is located entirely within the OU-1 boundaries and is estimated to contain over 68% of the dissolved phase perchlorate mass in groundwater at the site. The removal of perchlorate from groundwater beneath the facility will decrease the up-gradient source term and potentially reduce the duration of the proposed removal action of wellhead treatment for Operable Unit 3 (OU-3).

1.6 Project/Task Description (A6)

The Expanded Demonstration System remedial approaches identified for implementation include the addition of an extraction well and pump and an injection well, which will be merged with the existing Demonstration System treatment system. Expanded Demonstration System will increase the effectiveness of the Demonstration System system by increasing the groundwater treatment flow rate from 150 gpm to a maximum flow rate of 350 gpm, thereby increasing the treatment area. Expanded Demonstration System will utilize the Demonstration System groundwater treatment system, which includes aboveground granular activated carbon (GAC) adsorption, fluidized bed reactor (FBR) treatment, trimite filtration, and groundwater reinjection. The project objectives are as follows:

- Extend the overall effectiveness of the OU-1 treatment system.
- Expedite chemical mass reduction in the OU-1 area.
- Design a flexible system design that will be the final remedial action for OU-1.

1.7 Quality Objectives and Criteria for Measurement Data (A7)

This section presents the quality objectives for the project and the performance criteria necessary to meet these objectives. Included are discussions of the project data quality objectives (DQOs), the quantitative DQOs (precision, accuracy, and completeness), and the qualitative DQOs (comparability and representativeness). The overall QA objective is to generate data that are of known, documented, and defensible quality.

1.7.1 Data Quality Objectives

DQOs are statements that specify the quantity and quality of the data required to support project decisions. DQOs for this project were developed using the seven-step process *Guidance for the Data Quality Objectives Process* (U.S. EPA, 2000). The DQOs are presented in Table B-1. The QA procedures as well as the associated field sampling procedures contained in this SAP are focused on achieving these DQOs in a timely, cost-effective, and safe manner. Deviations from these objectives will require defining the cause or causes for noncompliance and will initiate the process of determining whether additional sampling and analyses will be required to attain project goals.

1.7.2 Quantitative Objectives: Precision, Accuracy, and Completeness

Precision quantifies the repeatability of a given measurement. Precision is estimated by calculating the relative percent difference (RPD) of laboratory and field duplicates, as shown in Equation (B-1).

$$\text{RPD}\,(\%) = \frac{|\text{Original} - \text{Duplicate}|}{(\text{Original} + \text{Duplicate})/2} \times 100 \qquad \text{(B-1)}$$

Table B-1. Data Quality Objective Steps for Assessment of Contaminated Soil and Groundwater

STEP 1 State the Problem	STEP 2 Identify the Decision(s)	STEP 3 Identify the Inputs to the Decisions	STEP 4 Define Study Boundaries	STEP 5 Develop Decision Rules	STEP 6 Specify Tolerable Limits on Errors	STEP 7 Optimize Sampling Design
The groundwater beneath NASA JPL has been found to contain elevated concentrations of perchlorate, carbon tetrachloride, and other VOCs. Based on these elevated concentrations, an on-facility target treatment zone has been identified.	Reduce contribution to off-facility groundwater by reducing chemical concentrations in on-facility groundwater.	The primary type of information that needs to be obtained in order to resolve the decision statement is laboratory analyses of groundwater and soil samples collected from wells set in drilled boreholes. Groundwater and soil samples will be analyzed for perchlorate, carbon tetrachloride,and several other VOCs.	An 8-acre by 100-feet-thick portion of the site, identified as the target treatment zone, contains over 68% of the dissolved ClO_4^- mass. This represents less than 3% of the volume of groundwater with ClO_4^- concentrations greater than 10 µg/L. There are no temporal boundaries for the OU-1 source area treatment system.	Provide evidence that chemical concentrations and aerial extent of perchlorate and carbon tetrachloride in groundwater within the uppermost water-bearing zone are decreasing. In addition, provide evidence that the groundwater sampling produces representative data that achieves monitoring objectives and supports project management decisions.	Statistical performance parameters have not been determined because limits on decision error will not be considered. Data validation will be performed by an in-house review.	The proposed sampling locations are based upon those presented in the Work Plan.

The laboratory will review the QC samples to ensure that internal QC data lies within the limits of acceptability. Any suspect trends will be investigated and corrective actions taken. The analytical precision acceptability limits for this project will be:

- Water: 20% for all analyses
- Vapor: 20%
- Soil: 30%.

Laboratory accuracy refers to the percentage of a known amount of analyte recovered from a given matrix. Percent recoveries for groundwater and soil samples are estimated by Equation (B-2).

$$\text{Recovery}(\%) = \frac{(\text{Spiked Sample}) - (\text{Original Sample})}{(\text{Amount of Spike Added})} \times 100 \qquad \text{(B-2)}$$

The recovery of most spiked organic compounds is expected to fall within a range of 70 to 130%. The recovery of spiked metals should be between 75 and 125%.

Completeness refers to the percentage of valid data received from actual testing done in the laboratory. Completeness is calculated as shown in Equation (B-3). The target completeness goal for all compounds is 90%.

$$\text{Completeness} = \frac{\text{Number of Measurements Judged Valid}}{\text{Total Number of Measurements}} \times 100 \qquad \text{(B-3)}$$

1.7.3 Qualitative Objectives: Comparability and Representativeness

Comparability is the degree to which one data set can be compared to another. To ensure comparability, samples will be collected at specified intervals and in a similar manner, and will be analyzed within the required holding times by accepted methods. All data and units used in reporting this project will be consistent with accepted conventions for groundwater and soil analyses. This approach will ensure direct comparability between the results from this effort and the results from other projects using the methods presented in this SAP.

Representativeness is the degree to which a sample or group of samples is indicative of the population being studied. Over the course of this effort, samples will be collected in a manner such that they are representative of both the chemical composition and the physical state of the sample at the time of sampling.

1.8 Special Training/Certification (A8)

All personnel performing fieldwork must comply with Occupational Safety and Health Administration (OSHA) requirements as specified in 29 CFR 1910. Personnel will have current records of Hazardous Waste Operations and Emergency Response (HAZWOPER) training and subsequent 8-hour refresher training. At least one person on the field team will be trained in first aid and certified in cardiopulmonary resuscitation (CPR).

Field team members will be adequately trained in field methods and sampling procedures outlined in this plan. Specifically, field team members will have training in the following field activities: drilling and well installation; well inspection; groundwater sampling; use of water-level indicators, peristaltic and submersible pumps, and related field equipment; sample handling, packaging, and shipping; and handling of investigation-derived waste (IDW). The Project Manager will maintain training records for all field personnel as part of the project file. Training records demonstrating compliance with OSHA requirements as specified above will be kept on site at all times.

1.9 Documentation and Records (A9)

The following general types of documents and records will be maintained for this project:

- SAP
- Well construction diagrams
- Project logbooks
- Sample chain-of-custody forms
- General project correspondence
- Laboratory data reports
- Sampling and analysis reports.

The Project Manager is responsible for maintaining the above records to meet the requirements of this SAP. This requirement includes the maintenance of all records and data necessary for QA reports to management, corrective actions, and other associated documentation. Project documentation will be maintained for a minimum of five years following completion of the project.

2.0 FIELD SAMPLING PLAN (DATA GENERATION AND ACQUISITION)

The following sections describe the field activities that will be performed as part of the Expanded Demonstration System interim action at NASA JPL. These activities include surveying to mark the proposed extraction well and injection well locations and the underground piping route. In addition, all well locations and elevations will be resurveyed after installation in order to assist in the determination of the water table elevations within the target treatment area. Subsequent activities will then include collection of groundwater-level elevations and groundwater and soil samples. Collection of these samples is necessary to evaluate the soil and groundwater source zone and the impact the remedial activities have on the concentrations and extent of perchlorate and carbon tetrachloride in groundwater. For the operation and maintenance (O&M) of the Source Area Treatment System, collection of water samples for field and laboratory analysis is necessary for system performance and compliance monitoring and system optimization.

2.1 Sampling Process Design (Experimental Design) (B1)

The proposed field activities and the rationale for their design are discussed in detail in the Work Plan.

2.2 Sampling and Analytical Requirements (B2)

The SAP has been prepared to ensure that the DQOs specified for this project are met; the field sampling protocols are implemented, documented, and reviewed in a consistent manner; and the data collected are scientifically valid and defensible. This section addresses the sampling and analytical requirements.

2.2.1 Extraction and Injection Well Installation

The extraction well (EW-03) and injection well (IW-03) will each consist of a 6-inch diameter low carbon steel casing spanning from 0 ft to 215 ft bgs with a 100 ft screened interval that spans from 215 to 315 ft bgs, as described in Section 4.0 of the Work Plan. The depth to the water table is approximately 210 ft below ground surface (bgs) in the target area. However, it can vary by up to 60 ft due to seasonal variations. The wells will be screened entirely in the upper 100 ft of the saturated zone, which extends to approximately 900 ft above mean sea level (amsl). Groundwater samples will be collected from groundwater extracted from EW-03 and from groundwater reinjected into IW-03.

2.2.2 Groundwater Sampling Procedures

Groundwater sampling and analysis will be conducted for existing wells (i.e., MW-7, MW-8, MW-11, MW-13, MW-16, and MW-24) comprising the groundwater monitoring network (refer to Section 4.4 of the Work Plan), injection wells, and the extraction wells in accordance with the protocol described in this SAP. Groundwater chemical analyses will be performed by a California Department of Health Services (DHS)-certified laboratory using approved methods. Ambient air quality will be monitored and noted throughout field activities, including groundwater sampling.

2.2.2.1 Groundwater-Level Measurement Procedures

Groundwater-level measurements will be taken from each well before purging and just prior to sampling. The following procedure will be used to obtain groundwater-level measurements:

- The water-level probe will be decontaminated as described in Section 2.2.4.
- The probe will be lowered slowly until the instrument alarm and light response indicate that the water surface has been encountered. The measurement will be taken from the surveyed point on the well's protective enclosure. A straight-edge bar will be placed across the scribed marks on the protector, and the water level will be measured to the bottom of the bar from a point directly in the center of the well casing or the access tube.
- The measurement will be checked by slowly raising and lowering the tape and watching the instrument response. The measurement will be recorded in the field logbook.

2.2.2.2 Well Purging and Sampling Procedures

As the well cover is removed, the air in the breathing zone will be monitored with a flame ionization detector (FID), or equivalent, to ensure that escaping volatile organic compounds (VOCs) do not pose an adverse health effect to the field sampling team. The instrument will be calibrated in accordance with the manufacturer's requirements. Calibration data will be recorded in the instrument use log.

2.2.2.2.1 Traditional Purging and Sampling

A peristaltic or submersible pump will be used to purge the well. Teflon™-lined polyethylene tubing that has been decontaminated in accordance with Section 2.2.5 of this SAP will be used to purge and sample each well. The intake will be raised and lowered through the water column to remove stagnant water. The outlet of the well will be routed to a flow through cell to measure field parameters. The effluent groundwater will be transferred into a container of known volume to monitor the amount of water purged from the well. The water level in the well will be observed with the water-level indicator and recorded on the purge log.

Well purging to "dryness" will be avoided if possible. The well purging procedure for fast recharging wells (recovery 80% or more of static condition within 2 hours) is as follows (San Diego County Department of Environmental Health [DEH], 2002):

1. Remove one borehole volume of water. A borehole volume will be calculated using Equation (B-4):

$$BV = \left(\frac{7.48\pi}{4}\right)\left[CD^2 + P\left(BD^2 - CD^2\right)\right]\left(WD - GW\right) \qquad \text{(B-4)}$$

where BV = borehole volume (gallons)
CD = casing diameter (feet)
P = porosity (0.30)
BD = borehole diameter (feet)

WD = well depth (feet)
GW = depth to groundwater (feet).

2. Conduct field water quality measurements (temperature, pH, salinity, conductivity, dissolved oxygen (DO), and oxidation-reduction potential [ORP]). The handheld meters used to collect these measurements will be cleaned and calibrated in accordance with the operation manual. Standard Methods for the Examination of Water and Wastewater and U.S. EPA Methods will be used to supplement operation manuals when making these measurements. Calibration data will be recorded daily.

3. Remove an additional one-half borehole volume of water. Conduct field water quality measurements again. If the first and second measurements of temperature, pH, and conductivity vary by less than 10 percent, purging is considered to be adequate and proceed to Step 5.

4. Repeat Step 3 until the measurements for temperature, pH, and conductivity vary by less than 10% or until three borehole volumes of water have been removed. When these criteria are met, a statement will be made in the logbook documenting that the criteria have been satisfied.

5. Allow well to recover to 80% of its static condition prior to collecting the sample.

If purging to "dryness" is unavoidable, the purging procedure for slow recharging (recovery of 80% of the static condition is not achieved within two hours) wells will be used. The slow recharge purging procedure is as follows (San Diego County DEH, 2002):

1. Remove one borehole volume of water.

2. Collect a sample no later than two hours after purging, or as soon as enough water is present to sample. Note that if the well recovers to greater than 80% in less than two hours, use the procedure above.

All purge water and water used to decontaminate the field equipment will be contained in 55-gallon drums or polyethylene tanks. The water will be relocated to an appropriate storage area.

2.2.2.2.2 Micropurging and Sampling

When appropriate, wells will be micropurged, which involves pumping at much lower rates than traditional purging methods. The objective of micropurging is to minimize stress to the groundwater system by decreasing drawdown caused by pumping. Pumping at a low flowrate effectively isolates the screened interval from the overlying (stagnant) casing water, thereby sampling water from the screened interval only. Typically, flowrates on the order of 0.1 to 0.5 L/min are used during micropurging.

Water will be purged from the well until field measurements of pH, temperature, DO, ORP, specific conductivity, and turbidity stabilize. Purge procedures and stabilization guidelines are covered in Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures (Puls and Barcelona, 1996). A peristaltic or submersible pump will be used to purge each monitoring well. Teflon™ fluorinated ethylene polymer (FEP) or similar tubing will be decontaminated in accordance with Section 2.2.6 and used for purging each well. Dedicated tubing will not require decontamination prior to use. The outflow of the well pump tubing will be routed to a flowthrough cell to measure field parameters. The effluent groundwater will then be transferred into a container of known volume to monitor the amount of water

purged from the well. The water level in the well will be observed during the purging process (if possible) with the water-level indicator.

2.2.2.3 Procedures for Sampling Wells Using a Peristaltic Pump

After the criteria for well purging have been met, the well can be sampled using a peristaltic pump, as outlined below:

- Sampling personnel will put on a new pair of disposable, powder-free, nitrile surgical gloves immediately before collecting samples at each location.

- To obtain a groundwater sample, the Teflon™-lined polyethylene tubing outlet will be disconnected from the flow through cell, and the corresponding sample containers will be carefully filled.

- The volatile organic analysis (VOA) vials will be filled through the sampling tube, taking care to reduce the flow until a meniscus is formed at the top of the vial. Each vial then will be preserved with two drops of hydrochloric acid (HCl), provided by the analytical laboratory, to reduce the pH to less than 2. The vial then will be capped and turned upside down to check for bubbles. If bubbles are present, the sample will be discarded and another vial will be filled, preserved, and checked for bubbles.

- Samples will be placed in ice chests or a refrigerator and maintained at approximately 4°C until shipment for analyses.

2.2.2.4 Procedures for Sampling Wells Using a Bailer

After the criteria for well purging have been met, the well can be sampled using a disposable Teflon™ bailer, as outlined below:

1. Sampling personnel will put on a new pair of disposable, powder-free, nitrile surgical gloves immediately before collecting samples at each location.

2. To obtain a groundwater sample, a disposable Teflon™ bailer will be lowered into the water slowly to prevent aeration. VOA containers will be filled first. After the bailer is retrieved from the well, a disposable Teflon™ sampling tube will be inserted in the top end of the bailer. Approximately 50 mL of water will be allowed to run through the tube before the VOA vials are filled. The VOA vials will be filled through the sampling tube, taking care to reduce the flow until a meniscus is formed at the top of the vial. Each vial then will be preserved with two drops of HCl, provided by the analytical laboratory, to reduce the pH to less than 2. The vial then will be capped and turned upside down to check for bubbles. If bubbles are present, the sample will be discarded; another vial will be filled, preserved, and checked for bubbles.

3. Samples will be placed in ice chests or a refrigerator and maintained at approximately 4°C until shipment for analyses.

2.2.2.5 Groundwater Samples for Field Measurement of Water Quality Parameters

Field measurements of water quality parameters will be measured. They include:

- pH
- DO
- Temperature
- Conductivity
- ORP
- Perchlorate (optional)
- Nitrate (optional)
- Sulfide (optional)
- Total organic carbon (optional).

2.2.2.6 Groundwater Samples for Laboratory Analysis

The groundwater will be analyzed for:

- Perchlorate
- Inorganic ions
- Sulfide
- Nitrogen
- VOCs
- Metals
- Alkalinity
- Total dissolved solids
- Total suspended solids
- Turbidity
- Biochemical oxygen demand
- Chemical oxygen demand.

2.2.3 Soil Sampling Procedures

A few select soil samples will be collected and then analyzed for perchlorate according to EPA Method 314.0. This analytical method provides a method detection limit (MDL) of 11 μg/kg and a practical quantitation limit of 50 μg/kg. Soil samples will be collected at depths where no prior soil samples have been collected during previous site assessment investigations.

Soil samples will be collected from the vadose zone and/or capillary fringe during well installation activities at selected depths and locations. Soil sampling will be conducted as follows:

1. The split-spoon sampler, continuous core barrel, and all associated sampling equipment will be decontaminated using the decontamination procedures for field equipment described in Section 2.2.4.

2. After reaching the desired depth, a 2.6-inch-I.D., 18-inch-long split-spoon sampler containing stainless steel sleeves will be driven into the soil.

3. The sampler will be retrieved from the borehole, and one-half of the split-spoon will be removed so that the soil recovered in the sleeves rests in the remaining half of the barrel.

4. The sleeve to be used for laboratory analysis will be removed from the lower end of the split-spoon sampler. Each end of the sleeve will be capped with a Teflon™ sheet, sealed with a polyethylene lid, and labeled.

5. All soil samples will be immediately sealed in a plastic bag and placed in an ice chest or a refrigerator, where they will be maintained at approximately 4°C until shipment for analyses.

6. All remaining soil samples will be disposed of with the soil cuttings.

2.2.4 System Monitoring

This section presents the sampling and analysis requirements for the various components of the remediation system. The number of samples and types of field and laboratory analyses for system monitoring are summarized in Table B-2. Groundwater samples will be collected at three points along the GAC portion of the system. Samples will be collected at the inlet, the midpoint, and the outlet sections of the GAC. Similarly, the inlet and the outlet of the FBR will be sampled. One sample will be collected from the multimedia filter outlet. Table B-3 provides the reporting limits for the analytical methods used for groundwater.

2.2.5 Decontamination Procedures

All nondisposable field equipment will be decontaminated as described below before each use to avoid cross-contamination between samples and to ensure the health and safety of the field crews

Commercially available distilled (DI) water and reagent-grade methanol will be used as intermediate rinses. The final rinse will use high-performance liquid chromatography (HPLC)-grade water (or equivalent). The following sequence will be used to clean all field equipment and sampling devices:

- Wash the samplers with Liquinox™ detergent and DI water and clean them with a stiff-bristle brush.
- Rinse with DI water.
- Rinse with methanol.
- Rinse with HPLC-grade water (or equivalent).
- Place the sampling equipment on a clean surface and air dry.

2.2.6 Disposal of Contaminated Materials

Several waste streams will result from the execution of this SAP. Wastes will be periodically sampled and analyzed for the organic and inorganic constituents noted in Table B-2 so that the ultimate disposal method for the wastes can be identified. NASA will be responsible for the ultimate disposal of both hazardous and non-hazardous wastes. A description of each waste stream is presented below.

Table B-2. Summary of Monitoring Parameters and Analytical Method

Constituent	Units	Analytical Method	Method Number	Method Detection Limit	Reporting Limit
Soil					
Perchlorate	µg/g	IC	314.0	11	50
Groundwater					
Perchlorate	µg/L	IC	314.0	1	2
Chlorate	mg/L	IC	300.0	0.05	0.1
Chloride	mg/L	IC	300.0	0.01	0.2
Bromide	mg/L	IC	300.0	0.2	0.5
Nitrate-Nitrogen (NO_3-N)	mg/L	IC	300.0	0.01	0.1
Nitrite-Nitrogen (NO_2-N)	mg/L	IC	300.0	0.01	0.1
Orthophosphate	mg/L	IC	300.0	0.02	0.5
Sulfate	mg/L	IC	300.0	0.07	0.5
Sulfide	mg/L	Titrimetric	376.1	0.4	1
Nitrogen	mg/L	Colorimetric	351.2	0.2	1
Carbon tetrachloride	µg/L	GC/MS	8260B	0.2	1
1,1-Dichloroethene	µg/L	GC/MS	8260B	0.2	1
1,2-Dichloroethane	µg/L	GC/MS	8260B	0.2	1
Tetrachloroethene	µg/L	GC/MS	8260B	0.2	1
Trichloroethene	µg/L	GC/MS	8260B	0.2	1
1,4-Dioxane	µg/L	MS (SIM)	8270C Mod	0.5	2
Arsenic	µg/L	ICP	6010B	0.037	0.1
Trivalent chromium	µg/L	ICP	6010B	0.006	0.02
Hexavalent chromium	µg/L	IC	7199	0.1	0.2
Alkalinity	mg/L	Titrimetric	310.1	0.1	1
Total dissolved solids	mg/L	NA	160.1	4	10
Total suspended solids	mg/L	NA	160.2	4	10
Turbidity	NTU	Nephelometric	180.1	NA	10
Biochemical oxygen demand	mg/L	NA	405.1	1	2
Chemical oxygen demand	mg/L	Colorimetric	410.4	5	10

Table B-3. Sampling and Analytical Requirements for Investigation Derived Waste [(a)]

Waste Type	Sampling/Analysis Frequency	Analysis
Drill cuttings	As containers are filled	Perchlorate, organics and metals listed in Table B-2, pesticides, and PCBs.
Purge water from wells	As containers are filled	Perchlorate, organics, and metals listed in Table B-2.

(a) All analyses to be performed at an off-site laboratory.

2.2.6.1 Soils

Soils associated with sampling operations have the potential of containing some level of perchlorate. Soil cuttings and any residual materials associated with sampling activities will be stored temporarily in approved containers, prior to transportation and disposal at an off-site licensed facility. Analytical results characterizing the contents of each storage container will be obtained to determine whether the materials will require disposal in either a hazardous or non-hazardous facility. Copies of the manifests for all containers of soil removed from the project site will be retained in the project files.

2.2.6.2 Groundwater and Decontamination Wastewater

Groundwater from well purging activities and any decontamination water generated during field sampling efforts will be stored temporarily in approved containers. Analytical results from the streams that constituted the wastewater will be obtained prior to transportation of the water off-site.

2.2.6.3 Used Personal Protective Equipment

The field activities will be performed in Level D personal protective equipment (PPE) and/or modified Level D PPE. Used PPE (if applicable) will be stored temporarily in 55-gallon drums prior to transportation and disposal at an off-site licensed facility.

2.2.6.4 Waste Transport, Disposal, and/or Treatment

Loading and transporting soil, groundwater/decontamination water, and used PPE (if applicable) will be coordinated with a specified NASA representative. Original copies of the manifest and disposal notification forms will be provided to the transporter for shipment. Copies of waste manifests and receipts for the disposal of wastes will be retained.

2.3 Sample Handling and Custody (B3)

This section presents sample handling and custody procedures for the remediation activities. These procedures will ensure proper handling, custody, and documentation of the samples from field collection through laboratory analyses.

2.3.1 Sample Handling

Groundwater samples are to be collected and containerized in order of decreasing volatility of parameters. The preferred collection order for groundwater samples is:

1. VOCs
2. perchlorate, nitrates, etc.
3. metals.

Additional sample collection and handling considerations associated with the fieldwork for this project include:

- Measurements of temperature, pH, specific conductivity, DO, salinity, and ORP will be made in the field prior to groundwater sample collection.
- A sufficient sample volume will be collected from each location sampled to serve the needs of all analyses (including matrix spikes, matrix spike duplicates, and field duplicates).
- All samples to be analyzed for volatile compounds will be collected and capped with zero headspace. Sample containers will have a special cap fitted with a Teflon™-lined septum, and will be filled to full and securely capped. The sample containers will be inverted, shaken, tapped, and visually inspected for air bubbles by the sample team prior to leaving the sample site. If air bubbles are observed, the entire sample collection process will be repeated.
- Sample containers for water samples will be filled to approximately 90% capacity, except for sample containers that will be analyzed for volatile compounds.

2.3.2 Sample Containers, Holding Times, and Preservation and Turnaround Times

Table B-4 presents sample container, holding time, and preservation requirements for the listed analytical parameters based on U.S. EPA SW-846 requirements. New, pre-cleaned sample containers will be used. The laboratory selected to receive the samples will supply containers.

Once collected, each containerized sample will be labeled and placed into a matrix-specific sample cooler. The sample cooler will serve as the shipping container and will be provided by the laboratory with the sample containers. The sample cooler will be packed with ice to cool samples to 4°C during shipment. Samples are to be transported to the laboratory promptly in order to provide ample time for analyses to be conducted within the established maximum holding times. The maximum interval between sample collection and shipment is to be one business day.

The Project Manager or designee is responsible for coordinating with the laboratory for sample shipment via laboratory pick-up or overnight delivery service. U.S. Department of Transportation (DOT) regulations concerning the shipment of environmental samples to a laboratory for analysis will be followed.

2.3.3 Sample Packaging and Shipping

Immediately after samples are collected and labeled for off-site laboratory analysis, they will be placed in a matrix-specific ice chest or cooler. The samples will be packed with shock-absorbent materials, such as bubble wrap, to prevent movement or breakage of the sample jars during transport. The ice chest will be filled with wet ice in order to meet the 4°C preservative requirement. A temperature blank will accompany each cooler.

The chain-of-custody will be placed in a zip-lock bag and taped to the inside of the cooler. The ice chest will be banded with packaging tape and custody seals will be placed along the ice chest lid in order to prevent or indicate tampering. The cooler containing the environmental samples will be picked up by the laboratory or arrangements can be made to have the cooler delivered to the laboratory by an overnight delivery service such as Federal Express. If an overnight delivery service is used, the package must be scheduled for priority overnight service so that the temperature preservative requirement is not exceeded.

Table B-4. Sample Containers, Holding Times, and Preservation Methods for Soil and Groundwater Samples

Constituent	Method Number	Sample Container	Preservation Method	Max. Holding Times
Soil				
Perchlorate	314.0	4 oz	Cool, 4°C	28 days
Groundwater				
Perchlorate	314.0	125-mL amber or plastic	Cool, 4°C	28 days
Chlorate	300	50-mL poly	Cool, 4°C	28 days
Chloride	300	50-mL poly	Cool, 4°C	28 days
Bromide	300	50-mL poly	Cool, 4°C	28 days
Nitrate	300	50-mL poly	Cool, 4°C	48 hours
Nitrite	300	50-mL poly	Cool, 4°C	48 hours
Orthophosphate	300	100-mL poly	Cool, 4°C	48 hours
Sulfate	300	50-mL poly	Cool, 4°C	28 days
Sulfide	376.1	500-mL glass	Cool, 4°C, ZnAc, NaOH, pH>9	7 days
Nitrogen	351.2	500-mL poly	Cool, 4°C, H_2SO_4, pH<2	28 days
VOCs	8260B	3 x 40-mL glass	Cool, 4°C, No headspace, pH<2 HCl	14 days
1,4-Dioxane	8270C Mod	1,000-mL amber glass	Cool, 4°C	7 days
Total metals	6010B	250-mL poly	Cool, 4°C	180 days
Hexavalent chromium	7199	100-mL poly	Cool, 4°C	24 hours
Alkalinity	310.1	200-mL poly	Cool, 4°C	14 days
Total dissolved solids	160.1	500-mL poly	Cool, 4°C	7 days
Total suspended solids	160.2	500-mL poly	Cool, 4°C	7 days
Turbidity	180.1	100-mL poly	Cool, 4°C	48 hours
Biochemical oxygen demand	405.1	1,000-mL	Cool, 4°C	48 hours
Chemical oxygen demand	410.4	100-mL plastic	Cool, 4°C, H_2SO_4, pH<2	28 days

2.3.4 Sample Documentation

Sample documentation includes sample designation, sample labeling, field notes, and chain-of-custody forms. Sample designation provides that each sample will be uniquely identified, labeled, and documented in the field at the time of collection. Each sample container will have a sample label affixed to the outside of the container in an obvious location. Example labels are presented in Figures B-2 and B-3. Information will be recorded on the label with water-resistant ink. The sample label will specify:

- Sample identification number
- Date and time of sample
- Preservation used
- Analytical methods
- Project name.

Client/Project Name: _____

Sample ID: _____

Date/Time: _____

Analysis:_____

Preservative: _____

Samplers Name: _____

Figure B-2. Sample Label for Water Samples

Client Name: _____

Sample ID: _____

Date/Time: _____

Analysis: _____

Samplers Name: _____

Sample Type: Grab Composite Other

Figure B-3. Sample Label for Soil Samples

The field notebook will be used to provide daily records of significant events, observations, and measurements during field investigations. The field logbook also will be used to document all sampling activities. All notebook entries will be made with indelible ink to provide a permanent record. Logbooks will be kept in the possession of the field technician during the on-site work and all members of the field team will have access to the notebook. These notebooks will be maintained as permanent records.

The field notebooks are intended to provide sufficient data and observations to reconstruct events that occurred during installation and sampling. All notebooks will be given a unique label and multiple notebooks will be assigned serial numbers. The following items will be recorded in the field logbook.

- Name, date, and time of entry
- Names and responsibilities of field crew members
- Name and titles of any site visitors
- Descriptions of drilling and sampling procedures, and problems encountered
- Number and amount of samples taken at each location
- Details of sampling location
- Identification numbers of all samples collected
- Date and time of collection
- Sample collection method
- Decontamination procedures
- Field measurements (e.g., DO, ORP, temperature, pH, and conductivity) and general observations.

Each sample container is to be logged using a chain-of-custody form prior to shipment or pickup by the laboratory. The chain-of-custody form will be signed by the individual responsible for custody of the sample containers and will accompany the samples to the laboratory. A sample chain-of-custody form is presented in Figure B-4. Information to be recorded on the chain-of-custody form should include:

- Sample matrix
- Sample collector's name
- Dates/times of sample collection
- Sample identification numbers
- Number and type of containers for each sample aliquot
- Type of preservation
- QC sample designation
- Analysis method
- Special handling instructions
- Destination of samples
- Name, date, time, and signature of each individual releasing the shipping container.

CHAIN OF CUSTODY

EMAX Laboratories, Inc.

1835 W. 205th Street, Torrance, CA 90501
Tel #: 310-618-8889 Fax #: 310-618-0818
Email: info@emaxlabs.com

PO NUMBER:

SAMPLE STORAGE

EMAX CONTROL NO. *

PROJECT CODE:

CLIENT

PROJECT

COORDINATOR

TEL FAX EMAIL

SEND REPORT TO

COMPANY

ADDRESS

EMAX PM

MATRIX CODE	PRESERVATIVE CODE
DW=Drinking Water	IC = Ice
GW=Ground Water	HC = HCl
WW=Waste Water	HN=HNO3
SD=Solid Waste SL=Sludge	SH=NaOH
SS=Soil/ Sediment	ST=Na2S2O3
WP=Wipes PP=Pure Products	ZA=Zinc Acetate
AR=Air	HS=H_2SO_4
O=	

ANALYSIS REQUIRED

TAT

- ☐ Rush ____hrs.
- ☐ Rush ____days
- ☐ 7 days
- ☐ 14 days
- ☐ 21 days
- ☐ 30 days
- ☐ ____days
- ☐

SAMPLE ID		SAMPLING			CONTAINER			MATRIX CODE	QC	PRESERVATIVE CODE								COMMENTS
LAB	CLIENT	LOCATION	DATE	TIME	NO.	SIZE	TYPE											
* 1																		
* 2																		
* 3																		
* 4																		
* 5																		
* 6																		
* 7																		
* 8																		
* 9																		
* 0																		

Instructions	Cooler #	Temp. (°C)	Sample #s

SAMPLER

COURIER/AIRBILL

RELINQUISHED BY	Date	Time	RECEIVED BY

NOTICE: Turn-around-time (TAT) for samples shall not begin until all discrepancies have been resolved. For samples received and discrepancies resolved after 1500 hrs, TAT shall start at 0800 hrs the next business day. The client is responsible for all cost associted with sample disposal. Samples shall be disposed of as soon as practical (but not prior to fifteen (15) calendar days) after issuance of analytical report unless a different sample disposal schedule is pre-arranged with EMAX. Disposal fee for samples defined by CA Title 22 as non-hazardous shall be $5.00 per sample. EMAX will return hazardous samples to the client at the client's expense unless directed in writing otherwise.

Figure B-4. Sample Chain of Custody for Water and Soil Samples

The laboratory will designate a sample custodian. This individual is responsible for inspecting and verifying the correctness of the chain-of-custody records upon sample receipt. The sample custodian will accept the samples by signing the chain-of-custody form and noting the condition of the samples in writing on the chain-of-custody or other receipt form. The sample custodian will notify the Project Team Leader of any discrepancies.

Samples received by the laboratory will be entered into a sample management system, which must include:

- Laboratory sample number
- Field sample designation
- Analytical batch numbers
- List of analyses requested for each sample container.

Immediately after receipt, the samples will be stored in an appropriate secure storage area. The analytical laboratory will maintain written records showing the chronology of sample handling during the analysis process by various individuals at the laboratory.

2.4 Analytical Methods (B4)

This section presents minimum criteria for laboratory selection and discusses methods to be used for analyses of soil, groundwater, and investigation-derived waste samples.

2.4.1 Laboratory Selection

An analytical laboratory that has successfully completed the Navy evaluation process through the Naval Facilities Engineering Service Center (NFESC) will perform all analyses, unless otherwise specified by NASA. Aqueous and soil samples for this task order will be analyzed by a California-certified laboratory.

Battelle's Project Manager will communicate sampling and analysis schedules to the laboratory with sufficient lead-time to meet contractual agreements with the laboratory.

2.4.2 Laboratory Analytical Methods

Laboratory analytical methods were selected based on the project DQOs and in consideration of the method detection limits achievable for each parameter. Each laboratory analytical method was chosen to address the intended use of the sampling data. Table B-2 shows the laboratory analytical methods that are to be used during the field activities.

2.4.3 Quantitative Reporting Limits

Factors that influence the quantitative reporting limits of analytical methods include the analytical method itself, sample matrix interference, and high concentrations of the target analyte. Actual reporting limits may vary from sample to sample in accordance with standard laboratory practices. Table B-2 provides the reporting limits for the analytical methods used for the soil and groundwater.

2.5 Quality Control Requirements (B5)

QA can be described as an integrated system of activities in the area of quality planning, assessment, and improvement to provide the project with a measurable assurance that the established standards of quality are met. QC checks, including both field and laboratory, are the specific operational techniques and activities used to fulfill the QA requirements.

2.5.1 Field Quality Control Checks

Proper sample acquisition and handling procedures are necessary to ensure the integrity of the analytical results. All procedures will be followed in both the field and the laboratory. The collection frequency for each QC sample is listed in Table B-5. The field QC samples will be assigned unique sample numbers and submitted to the analytical laboratory. If abnormalities are detected in field QC checks, the data associated with the QC checks will be flagged and appropriate actions will be taken to rectify issues.

Table B-5. QC Sampling Collection Frequency

Type of Sample	Number of Samples
Field Duplicates	10%; if <10 per day, one sample will be collected
Equipment Rinsate[(a)]	1 per day
Trip Blank	1 per cooler
Field Blank	1 per day
Laboratory Quality Assurance[(b)]	5%

(a) Required to verify decontamination between samples where non-dedicated equipment is used.
(b) For MS/MSD analyses.

2.5.1.1 Field Duplicate Samples

Field duplicate samples will be collected at a rate of 10% of the total number of samples during a sampling event. If fewer than 10 samples are collected, one duplicate sample will be collected. For all water samples, duplicate samples will be collected by retaining consecutive samples from the sample pump.

2.5.1.2 Equipment Rinsate Blanks

Equipment rinsate blanks will be collected daily to ensure that non-dedicated sampling devices (i.e., Teflon™-lined polyethylene tubing) have been decontaminated effectively. Equipment rinsate blanks will consist of the final HPLC-grade (or equivalent) rinsewater used in the final step of the sampling equipment decontamination procedure. Rinsate samples will be collected at a frequency of one per day during sampling events. The rinsate QA samples for the split-spoon samplers used to collect soil samples will be obtained prior to collection of the samples by rinsing through the decontaminated split-spoon sampler containing sleeves with HPLC-grade water (or equivalent). The water will be collected in a 40-mL VOA vial and returned to the laboratory for analysis. A peristaltic or submersible pump with Teflon™-lined polyethylene tubing will be used to collect the groundwater samples. The rinsate samples will be collected following decontamination of the tubing and prior to collection of the groundwater samples. The rinsate blanks will be collected by rinsing through the decontaminated tubing with HPLC-grade water. The water will be collected in 40-mL VOA vials and returned to the laboratory for analysis. Equipment rinsate blanks will be analyzed for VOCs only.

2.5.1.3 Trip Blanks

Trip blank samples will accompany each cooler that contains samples being submitted for volatile parameter analysis. Trip blanks will be prepared at the laboratory by filling 40-mL VOA vials with HPLC-grade water. Trip blanks are not to be opened in the field.

2.5.1.4 Field Blanks

Field blanks for groundwater sampling will be collected daily and will consist of three 40-mL VOA vials. The vials will be filled with HPLC-grade water prior to collection of a groundwater sample, and the uncapped vials will be placed upwind of the well during collection of the groundwater sample. Following groundwater sample collection, the vials will be acidified, capped, labeled, and recorded in the field logbook. The purpose of this type of blank is to detect possible contamination of the sample from airborne hydrocarbons during sample collection.

2.5.2 Laboratory Quality Control Checks

Laboratory QC is addressed through the analysis of laboratory QC samples, documented internal and external laboratory QC practices, and laboratory audits. Three types of laboratory QC samples will be used in this project: laboratory blank samples, MS/MSD samples, and laboratory control spikes (LCSs). Definitions of each type of laboratory QC sample are listed below. Analytical results for these samples will become the quantitative focus of the laboratory QC activities. For laboratory measurements, if any of the QC checks are outside the acceptance criteria, corrective actions will be taken. The laboratory QC checks, acceptance criteria, and corrective actions are listed in Table B-6.

Table B-6. Quality Control, Acceptance Criteria, and Corrective Action

QC Sample Type	Acceptance Criteria	Corrective Action
Procedural blank	<5 × MDL	Results examined by analyst. Corrective action (re-extraction, reanalysis) or justification document.
Blank spike	80-120%	
Calibration	5-point calibration curve (RSD≤ ± 20%); mid-range NIST standard solution (RSD≤ ± 20%) (Battelle SOP, Appendix H)	Investigate the problem, resolve the problem, and recalibrate.
Calibration check	Mid-range calibration solution (RSD≤ ± 30%) (every 10 samples)	Investigate the problem, resolve the problem, recalibrate, and re-analyze affected samples.

MDL = Minimum detection limit is estimated from the lowest calibration standard solution. Samples below the MDL will be reported as not detected (ND).
RSD = relative standard deviation.

Laboratory blank samples are designed to detect contamination of routine samples that occurs in the laboratory. Laboratory blanks verify that method interference caused by contaminants in solvents, reagents, glassware, and other sample processing hardware are known and minimized. Laboratory blanks are deionized water for aqueous samples. A minimum of one laboratory blank will be analyzed each day that routine samples are analyzed. The concentration of the target compounds in the laboratory blank sample must be less than or equal to the reporting limit. If the blank is not under the specified limit, the source contamination is to be identified and corrective actions taken.

MS and MSD samples are designed to check the precision and accuracy of the analytical methods through the analysis of a normal sample with a known amount of analyte added. Additional sample volume for MS and MSD samples will be collected in the field in the same manner as field duplicate samples. In the laboratory, two portions of the sample are spiked with a standard solution of target analytes. MS and MSD samples will be analyzed for the same parameters as the routine samples, and analytical results will be evaluated for precision and accuracy of the analytical method and effects of the sample matrix. The MS and MSD samples will be collected from 5% of all routine samples.

Laboratory control samples include blank spikes and blank spike duplicates. Blank spike samples are designed to check the accuracy of the analytical method by measuring a known concentration of an analyte in the blank spike samples. Blank spike duplicate samples are designed to check the accuracy and precision of the analytical method by measuring a known concentration of an analyte in the blank spike duplicate sample. Blank spike and blank spike duplicate samples are prepared by the laboratory using clean laboratory matrices spiked with the same spiking compounds used for matrix spikes at levels approximately 10 times greater than the method detection limit.

2.6 Instrument/Equipment Testing, Inspection, and Maintenance (B6)

Various field instruments will be used during the field activities. Such instrumentation may include a water quality meter for measuring pH, DO, specific conductivity, ORP, and temperature; water level indicator for measuring water levels in wells; and an FID for measuring VOCs in breathing zones. A list of field instruments that will be used for during the remediation activities at NASA JPL is provided in Table B-7.

Table B-7. Field Meters

Matrix	Parameter	Instrument
Groundwater	Water quality parameters (DO/ORP/temperature/conductivity/ pH)	Horiba U-22/Horiba U-10
Groundwater	Groundwater-level	Electric water level indicator or oil/water interface probe
Groundwater	Various (perchlorate, nitrate, sulfide, TOC)	Ion selective electrodes
Soil/Breathing Zone	Organic vapors	Photovac FID or equivalent

Field instrument maintenance will be documented in the field logbook for each field instrument used during field activities. Field equipment will be maintained when routine inspections indicate the need for maintenance. In the event that a piece of equipment needs repair, a list of the field equipment manufacturers' addresses, telephone numbers, and points of contact will be maintained on site during field activities. Field equipment routine maintenance may include the following:

- Calibrating equipment according to manufacturer directions
- Removing surface dirt and debris
- Replacing/cleaning filters when needed
- Ensuring proper storage of equipment
- Inspecting instruments prior to use
- Charging battery packs when not in use
- Maintaining spare and replacement parts in field to minimize downtime.

Laboratory instrument maintenance, including standard preventive maintenance procedures and schedules, will be performed in accordance with the method documentation.

2.7 Instrument/Equipment Calibration and Frequency (B7)

Methods for calibrating field instruments will follow the specific instrument manufacturers' recommendations. All field instruments will be calibrated before each day of use; and a calibration check at the end of the day will be performed to verify that the instrument remained in good working condition throughout the day. If the calibration check at the end of the day does not meet acceptance criteria, then that day's data will be flagged and the instrument calibration checks will increase to the operator's satisfaction that the instrument remains true to the initial calibration.

Laboratory instrument calibration will be performed as specified in the method documentation. Specific laboratory calibration techniques are established for the U.S. EPA methods to demonstrate that the analytical instrument is operating within the design specifications and that the quality of the data generated can be replicated.

2.8 Inspection/Acceptance Requirements for Supplies and Consumables (B8)

Any supplies and consumables used in the sample collection process or instrument calibration, such as sample bottles, pump tubing, deionized water, calibration gases, etc., will be inspected upon receipt and prior to use. The sample tubing should also come with a certificate of acceptance. At a minimum, the Project Manager or a field team member will inspect the tubing upon receipt for damage or broken seals.

2.9 Non-direct Measurements/Data Acquisition Requirements (B9)

Non-direct measurement data are not anticipated as part of the field implementation or field decision-making aspects of this project.

2.10 Data Management (B10)

The purpose of the data management section of this SAP is to briefly describe the procedures that will be used to maintain data quality throughout the project. These operations include, but may not be limited to, data recording, data reduction, and data reporting.

2.10.1 Data Recording

All field observations and laboratory results will be linked to a unique sample location through the use of the sample identification system. Field observations and measurement data will be recorded on the field forms and in a field notebook to provide a permanent record of field activities. All data that are hand-entered will be subjected to a review by a second person to minimize data entry errors. A check for completeness of field records (logbooks, field forms, databases, electronic spreadsheets) will ensure that all requirements for field activities have been fulfilled, complete records exist for each activity, and the procedures specified in this SAP have been implemented. Field documentation will ensure sample integrity and provide sufficient technical information to recreate each field event.

2.10.2 Data Reduction

The data will be reviewed by the contractor to determine if the qualitative parameters of representativeness and comparability have been achieved. In general, the review will be accomplished by comparing the chain-of-custody and field notebook entries with the data for the sample. If the reported concentrations of a field sample from a specific location do not reflect historical data, then efforts will be made to determine if the data reflect an actual change in environmental conditions at that sampling point, or if the integrity of the sample was compromised during collection, preservation, shipping, or analysis. Conversely, if some level of analyte historically present in samples from a specific location is no longer present, then similar efforts will be made to confirm that change in concentration. QA/QC requirements that bracket questionable data again will be reviewed to confirm the performance of instrumentation during the time when questionable data were generated. Any deviations will be documented, and corrective actions will be taken to determine if the data meet project goals. If the data do not meet project goals, then the need for additional sampling and analysis will be determined.

2.10.3 Data Reporting

Following the data review process, the sample results will be entered into an electronic database. This electronic database will be submitted to NASA in a format compatible with the Naval Electronic Data Deliverable (NEDD). Data will be compiled with spatial and temporal qualifiers so that it will be possible to rapidly plot or review changes in the concentrations of target analytes at each sampling point over time. Hard copies of the data reports received from the laboratories will be filed chronologically in three-ringed binders and will be stored separately from the electronic files. Hard copies of data signed by a representative of the analytical laboratory will be compared to any electronic versions of the data to confirm that the conversion process has not modified the reported results. Any additional reporting formats will be completed, and electronic and hard copies will be stored in different locations at the contractor's facilities.

3.0 ASSESSMENT AND OVERSIGHT

This section describes the activities for assessing the effectiveness of project implementation and associated QA and QC activities. The purpose of assessment is to ensure that the SAP is implemented, as prescribed.

3.1 Assessment and Response Actions (C1)

Assessments that may be performed during continued site assessment activities at NASA JPL include, but are not limited to, the following: technical system audits, audits of data quality, and data quality assessments.

3.1.1 Performance and System Audits

Technical systems audits and audits of data quality may be conducted periodically during site assessment activities by the Battelle QAO at the request of the Battelle Project Manager. In addition, the Battelle Project Manager/QAO will conduct regular audits of the field and laboratory data as they are generated as well as data/sample collection procedures. This schedule of QA checks will require the cooperation of the laboratory regarding timely delivery of reports. However, it will ensure that data quality issues are identified early, rather than at the end of the investigation.

If significant variances are found during the audit, the Battelle QAO may,conduct additional audits. Additional audits may include a visit to the field and to the laboratory, if required and if determined to be necessary by the Battelle Project Manager. The Battelle QAO will review the SAP.

For those audits resulting in variances, the Project Team Leader or the laboratory coordinator will submit a response in writing to the Battelle QAO. Reports will be submitted to NASA through the RPM.

3.1.2 Corrective Action

Corrective actions may be initiated by any of the participants of the data generation (field technician or laboratory analyst), reporting (laboratory director or field team leader), and validation process (Battelle Project Manager or QAO). Note that it is important to generate corrective actions early in the process so that the problem has a greater chance of being resolved in a timely and cost-effective manner. An example Corrective Action Report is presented in Figure B-5.

For field measurements, if the final calibration check is outside acceptable limits, then the associated data collected that day will be flagged. On the following day, a single point continuing calibration check will be run after every five wells monitored (or samples analyzed) to determine how long the initial calibration holds. Calibration frequencies will be adjusted accordingly.

For laboratory measurements, if any of the QC checks (MS, MSD, laboratory control samples, or laboratory blank) are outside the acceptance criteria (for accuracy, precision, and cross-contamination), the laboratory will follow the corrective actions that are outlined in the Laboratory Quality Assurance Plan (LQAP).

3.2 Reports to Management (C2)

Project reports prepared by Battelle will be submitted to NASA through the RPM. The schedule and additional recipient list for submission of these reports following completion of remedial activities will be decided accordingly.

CORRECTIVE ACTION REPORT	
SECTION A: STATEMENT OF PROBLEM (TO BE COMPLETED BY INITIATOR)	
(a) Item of nonconformance:	(b) Number:
(c) Location of nonconforming item:	(d) Date:
(e) Name, organization, and telephone number of person initiating NCR	(f) Date nonconformance found:
(g) Individual/organization responsible for the resolution of the nonconformance:	
(h) Reference:	
(i) Description of nonconformance: (1) identification of nonconforming item or service; (2) requirements, including the specific reference documented by title, revision, and its unique identification number; and (3) as found conditions:	
(j) Signature of initiator:	Date:
(k) QA Manager concurrence:	Date:
(l) STOP WORK order required YES NO	

Figure B-5. Sample Corrective Action Report

SECTION B: PROBLEM RESOLUTION (TO BE COMPLETED BY THE RESPONSIBLE INDIVIDUAL/ORGANIZATION)	
(a) Responsible individual/organization:	
(b) Proposed resolution:	
(c) Root cause:	
(d) Actions taken to prevent recurrence:	
Responsible individual:	Date:

Figure B-5. Sample Corrective Action Report (continued)

4.0 DATA VALIDATION AND USABILITY

This section is divided into three elements that describe the QA activities that occur after the data collection phase of the project has been completed to ensure that data conform to the specified criteria and thus satisfy monitoring objectives.

4.1 Data Review and Verification (D1)

The data generated for this project will be reviewed by the Battelle QAO and verified by either an independent outside review or in-house review.

4.2 Verification Methods (D2)

The data verification and reporting process for the field data involves ensuring that calibration of instruments, field blanks, and field duplicates are within the acceptance criteria. The verification process for the laboratory data involves ensuring that hold times, precision, accuracy, laboratory blanks, and detection limits are within the acceptance criteria outlined in this SAP.

The field and laboratory personnel will provide the Battelle Project Manager with all the data. The Battelle Project Manager or designee then will send the laboratory data either to an outside independent review company or to in-house review for data verification. The Battelle QAO will be responsible for overall review of the data verification results, for compliance with the specified DQOs. After this QA procedure is complete, the Battelle Project Manager will incorporate the verified data into final reports.

4.3 Reconciliation With Data Quality Objectives (D3)

Data collected during the field efforts will be reconciled with the DQOs by preparing summary tables, charts, figures, or performing other types of data analyses that facilitate direct comparison of data collected during the baseline through the entire extent of the project. Comparisons will be made on a parameter-specific basis, concentrating on the contaminants of concern. Comparisons also will facilitate an analysis of contaminant concentration trends through time and space.

5.0 REFERENCES

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APPENDIX C

Site Health and Safety Plan

This Site Health and Safety Plan (SHASP) describes requirements for the site remedial activities at the NASA JPL Facility.

Title of the Project: OU1 Remedial Design (RD)/Remedial Action (RA) Work Plan.

Organization Responsible for Implementing RD/RA Work Plan: Battelle

Effective Date of Plan: September 2006

Keith Fields
Battelle Project Manager

8/18/06
Date

For
Linc Remmert
Battelle Project HSO

8/14/06
Date

Bernard Himmelsbach, CIH
Battelle Health and Safety Representative

8/14/06
Date

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ACGIH	American Conference of Governmental Industrial Hygienists
CCl_4	carbon tetrachloride
CFR	Code of Federal Regulations
CIH	Certified Industrial Hygienist
CNS	central nervous system
CPR	cardiopulmonary resuscitation
DI	deionized
EMS	Emergency Medical Services
ESH&Q	Environmental, Safety, Health, and Quality
FID	flame ionization detector
GFCI	ground fault circuit interrupter
HASP	Health and Safety Plan
HSA	hollow-stem auger
HSDB	Hazardous Substances Database
HSO	Health and Safety Officer
IDW	investigation-derived waste
IR	Installation Restoration
JPL	Jet Propulsion Laboratory
LO/TO	lock-out/tag-out
MSDS	Material Safety Data Sheets
NASA	National Aeronautics and Space Administration
NIOSH	National Institute for Occupational Safety and Health
O&M	operation and maintenance
OEHHA	Office of Environmental Health Hazard Assessment
OSHA	Occupational Safety and Health Administration
PEL	permissible exposure limit
PEL/TWA	permissible exposure limit/time-weighted average
PID	photoionization detector
PPE	personal protective equipment
ppm	part(s) per million
SAP	Sampling and Analysis Plan
SHSO	Site Health and Safety Officer
SHSP	Site Health and Safety Plan

SSO	Site Safety Officer
STEL	short-term exposure limit
TCE	trichloroethene
TLV	threshold limit value
TWA	time-weighted average
VOC	volatile organic compound
USACE	United States Army Corp of Engineers
USDHH	United States Department of Health and Human Services
U.S. EPA	United States Environmental Protection Agency
UV	ultraviolet

The following persons will be provided copies of the approved Site Health and Safety Plan and any subsequent revisions.

Title	Name and Contact Information
Battelle Project Manager	Keith Fields Battelle Memorial Institute 505 King Avenue Columbus, OH 43201 (614) 424-7723 fieldsk@battelle.org
Battelle Project Quality Assurance Officer	Betsy Cutie Battelle Memorial Institute 505 King Avenue Columbus, OH 43201 (614) 424-4899 cutie@battelle.org
Battelle Project Health and Safety Officer	Linc Remmert Battelle Memorial Institute 505 King Avenue Columbus, OH 43201 (614) 424-3678 remmertl@battelle.org
Battelle Site Health and Safety Manager (or delegates thereof)	Dave Clexton Battelle Memorial Institute 7029 Fern Place Carlsbad, CA 92009 (760) 476-9144 clextond@battelle.org
Battelle Project Engineer	Ben Headington Battelle Memorial Institute 505 King Avenue Columbus, OH 43201 (614) 424-5489 headingtonb@battelle.org Shane Williams Battelle Memorial Institute 505 King Avenue Columbus, OH 43201 (614) 424-5792 williamsts@battelle.org

1.0 ADMINISTRATIVE INFORMATION

This Site Health and Safety Plan (SHSP) is written for work performed by Battelle at the National Aeronautics and Space Administration (NASA) Jet Propulsion Laboratory (JPL), Pasadena, California. This SHSP is intended to meet the requirements of:

- United States Army Corp of Engineering (USACE) *Safety and Health Manual*, EM 385-1-1 (USACE, 2003)
- Title 29, Code of Federal Regulations (CFR) 1910 and 29 CFR 1926
- U.S. Environmental Protection Agency (EPA) Standard Operating Safety Guidelines for Hazardous Waste Operations (U.S. EPA, 1992)
- Navy/Marine Corps Installation Restoration (IR) Manual (U.S. Navy, 2001)
- California Code of Regulations, Title 8 Section 5192

1.1 Scope of Site Health and Safety Plan

This SHSP has been prepared for use by Battelle project personnel and their subcontractors for work at NASA JPL. The plan is written for the specific site conditions, purposes, tasks, dates and personnel specified. If these conditions change, this plan will be amended and reviewed by those named in Section 1.2.

All site activities will be performed in accordance with the documents listed above, especially 29 CFR 1910.120. All Battelle employees involved in fieldwork at NASA JPL will have completed the required training programs and maintained qualification through annual refresher training. They are under a program of medical surveillance and are certified to wear respiratory protection as specified in 29 CFR part 1910.134. Full details of the Battelle safety training, Respiratory Protection, and Medical surveillance Programs are given in the Battelle Environment, Safety, Health and Quality (ESH&Q) Training Program (Battelle, 2005a), Respiratory Protection Program (Battelle, 2005b), and the Chemical Safety Information Program - Medical Consultation (Battelle, 2005c), respectively.

This SHSP was prepared from the best available information concerning site conditions at the time. The health and safety specifications in this SHSP are based on reasonable knowledge that chemicals, such as volatile organic chemicals, including carbon tetrachloride and trichloroethene (TCE), perchlorate, and 1,4-dioxane, are present in soil and groundwater.

1.2 Key Personnel and Responsibilities

Key Battelle personnel for this project include:

- Project Manager – Keith Fields
- Project Engineers – Ben Headington, Shane Williams
- Certified Industrial Hygienist (CIH) – Bernard Himmelsbach
- Health and Safety Officer (HSO) – Linc Remmert
- Site Health and Safety Officer (SHSO) – Dave Clexton or delegates thereof

All project field staff have completed comprehensive health and safety training, which meets the requirement of Title 29 Code of Federal Regulations – Part 1910.120 (29 CFR 1910.120). The SHSO or the alternate SHSO will have:

- Completed the required training for this project assignment
- The responsibility for completing the required field forms and reports
- The authority to modify and stop work, or remove personnel from the site if working conditions may affect on-site and off-site health and safety
- First Aid and cardiopulmonary resuscitation (CPR) certifications and be trained in blood borne pathogens control.

Specific project safety responsibilities for these key personnel are detailed below.

1.2.1 Project Manager Responsibilities

As the Project Manager, Mr. Keith Fields is responsible for generating, organizing, and compiling the SHSP, which describes planned field activities and potential hazards that may be encountered at the site. Mr. Fields also is responsible for ensuring that adequate training and site safety briefing(s), including the provision of safety equipment, are provided to the project field staff. Mr. Fields will provide a copy of this SHSP to each member of the project field staff and one copy to each subcontractor prior to the initiation of field activities. Associated health and safety responsibilities will include:

- Coordinating the activities of all field personnel, including their signed acknowledgement of the SHSP.
- Selecting a SHSO and field personnel for the work to be undertaken on-site.
- Ensuring that the assigned tasks are being completed as specified by this SHSP.
- Providing authority and resources to ensure that the SHSO is able to implement and manage safety procedures.
- Preparing reports and recommendations regarding project to safety the client and concerned personnel.
- Ensuring that the SHSO is aware of all provisions of this SHSP and that all on-site personnel are instructed about safety practices and emergency procedures as defined in this SHSP.
- Ensuring that the SHSO is monitoring site safety.

1.2.2 HSO/CIH Responsibilities

The HSO, Mr. Linc Remmert, and/or CIH, Mr. Bernard Himmelsbach, are responsible for developing and coordinating the health and safety program outlined in this SHSP. They are also responsible for reviewing and approving the SHSP for accuracy and incorporating any new information or guidelines that aid the Project Manager and SHSO in further definition and control of the potential health and safety hazards associated with this project. Mr. Remmert/Mr. Himmelsbach also have the authority to suspend or modify work practices for safety reasons and to dismiss individuals whose site conduct endangers the health and safety of others.

1.2.3 SHSO Responsibilities

The SHSO, Mr. Dave Clexton, has a direct line of authority from the HSO to implement specific health and safety requirements for specific site activities, and for ensuring that all team members, including subcontractors, comply with the SHSP. It is Mr. Clexton's responsibility to inform the subcontractors and other field personnel of chemical and physical hazards as he becomes aware of them. Mr. Clexton has the authority to suspend work if he feels the operations threaten the health and safety of the field team or the surrounding population and to dismiss individuals whose site conduct endangers the health and safety of others.

Mr. Clexton or his designee is responsible for completing and submitting the following forms (Attachment 1):

- Safety Compliance Agreement Form
- Tailgate Safety Meeting Form
- Air Monitoring Data Sheet
- Accident/Incident Analysis Form

Additional SHSO responsibilities include, but are not limited to, the following:

- Evaluating weather conditions and chemical hazard information and making recommendations to the Project Manager about any modification to this SHSP or personal protective equipment (PPE) requirements to maintain personnel safety.
- Approving all field personnel working on-site, taking into consideration their level of training, physical capacity and their eligibility to wear protective equipment necessary for the assigned tasks.
- Monitoring the compliance of field personnel for the routine and proper use of protective equipment that has been required for each task.
- Enforcing the "buddy system" as appropriate for site activities.
- Posting the location and route to the nearest medical facility and arranging for emergency transportation to the nearest medical facility.
- Posting the telephone numbers of local public emergency services.
- Entering the exclusion zone, for rescue of personnel only, after emergency services have been notified and appropriate precautions taken. Response effort must be within the level of training of the SHSO and appropriate equipment must be available.
- Observing field team members for signs of exposure, stress, or other conditions related to pre-existing physical conditions or site work activities.

1.2.4 Project Field Staff Responsibilities

The project field staff is responsible for ensuring that activities are performed in accordance with the approved SHSP, and that deviations from the SHSP are based upon encountered field conditions that are well documented in field notes and approved by the SHSO. The project field staffs' health and safety responsibilities include:

- Following the SHSP and the direction of the SHSO.

- Reporting any unsafe conditions or practices to the SHSO.
- Reporting all facts pertaining to incidents that result in injury or exposure to toxic materials to the Project Manager and SHSO.
- Reporting any equipment malfunctions or deficiencies to the Project Manager.
- Reviewing the SHSP as necessary.

It is the responsibility of individual organizations involved in field activities to ensure understanding of and compliance to the SHSP by its on-site employees or representatives working in controlled areas. Failure by any person to adhere to this SHSP may result in their removal from the site.

1.2.5 Subcontractor Responsibilities

Battelle is the lead and prime contractor for the activities associated with this project and, therefore, is responsible for subcontractor health and safety while under contract with Battelle and engaged in work at NASA JPL. Battelle will inform subcontractors of the site emergency response procedures, and any potential fire, explosion, health, safety, or other hazard by making this SHSP and site information available on-site. All Battelle subcontractors are responsible for:

- Attending the health and safety briefing given by the SHSO covering the requirements of this SHSP
- Providing their own, company provided, PPE
- Providing documentation that their employees have been trained in health and safety in accordance with applicable federal, state, and local laws and regulations
- Providing evidence of medical surveillance and medical approvals for their employees
- Designating their own Site Safety Officer (SSO) responsible for ensuring that their employees comply with their own Health and Safety Plan (HASP) and taking any other additional measures required by their site activities
- Signing the Safety Compliance Agreement Form (Attachment 1) as a part of standard safety protocol. All field personnel performing on-site work will sign the Safety Compliance Agreement Form. Individuals who refuse to sign this agreement will be prohibited from working on this project.

1.2.6 Site-Specific Safety Briefing

A site-specific safety/pre-entry briefing will be held daily prior to the start of any site activities at NASA JPL, and at other times as necessary to ensure that all field personnel and visitors are aware of the health and safety hazards at the site.

2.0 PROJECT TASKS

The major Battelle tasks associated with this contract include the following:

- Mobilization
- System installation
- System start-up, operation, and maintenance
- Investigation-derived waste (IDW) disposal
- Demobilization

Subcontractors are required to prepare their own HASP for drilling and well installation activities. The Battelle HSO will review the subcontractors HASP to ensure the HASP covers all aspects of the subcontractors' responsibilities for this project. The hazard risk assessment provided in the following section is for risks Battelle field personnel might encounter while working on-site during the drilling and well installation activities. Subcontractors are expected to follow their individual HASPs as well as guidelines included in the SHSP.

3.0 HAZARD/RISK ASSESSMENT

This section discusses chemical, physical, and environmental hazards to workers on the site. Section 3.1 discusses hazards associated with the project tasks listed in Section 2.0. Table 1 lists major hazards associated with these tasks and methods to mitigate the hazards. Section 3.2 discusses the chemicals of interest at JPL and includes information such as exposure limits and signs and symptoms of exposure. Table 2 lists the primary health hazards and exposure limits for chemicals covered in Section 3.2. Material Safety Data Sheets (MSDS) information for compounds listed in Table 2 is provided in Attachment 2. Permissible Exposure Levels (PELs) are Occupational Safety and Health Administration (OSHA) permissible exposure limits for airborne concentrations of toxic substances measured as an 8-hour Time-Weighted Average (TWA). The OSHA PELs are the recognized levels to which the site monitoring will adhere. Short-Term Exposure Limits (STELs) are OSHA short-term limits measured as a 15-minute TWA. OSHA requires that controls be implemented when employee exposure exceeds these limits. The Threshold Limit Values (TLVs) are health and safety guidelines recommended by the American Conference of Governmental Industrial Hygienists (ACGIH). If contaminant levels exceed 50% of the TLV or PEL and persist for greater than 10 minutes, engineering and/or administrative control measures will be implemented. During groundwater monitoring, field personnel have the potential to be exposed to both contaminated groundwater and contaminants in the vapor phase. Risk of contamination from the operation and maintenance (O&M) of the groundwater treatment system and site assessment activities comes mainly from contaminants in the vapor phase.

Section 3.3 discusses physical hazards identified with this site including those associated with fire, use of heavy equipment, slip/trip/fall, lifting, tool and equipment, and heat stress. Section 3.4 discusses biological hazards associated with the physical location of the site including contact with flora/fauna.

Daily tailgate safety meetings will be held at the start of each workday to discuss potential chemical, physical and environmental hazards and preventative safety measures. Attendance will be mandatory for all employees and a Tailgate Safety Meeting Form (Attachment 1) will be completed. Task Hazard Analyses have been developed for each major field activity/work phase and are presented in Table 1. The following sections describe the specific hazards anticipated in more detail, and the control measures to be implemented to minimize or eliminate each hazard. This information will be used to augment daily safety meetings intended to heighten safety and hazard awareness on the job.

3.1 Hazards Associated with Tasks

Due to the geographic location of JPL, heat stress may be a potential hazard to workers performing work associated with all tasks in the summer months. Heat stress hazards will be assessed in detail in Section 3.4.7. Other hazards associated with Battelle tasks are analyzed as follows:

3.1.1 Hazards Associated with Mobilization and Demobilization

The main hazards associated with mobilization and demobilization of field personnel and equipment are electrical shock from system setup, objects striking the heads of field personnel, and general site hazards such as heat and biological hazards. Methods of mitigating these hazards are listed in Table 1.

Table 1. Hazard Sources and Mitigation During Field Activities at JPL

Hazard	Project Tasks	Mitigation Methods
Slip/trip/ fall	All tasks	Maintain good housekeeping. Limit work area with boundary marking tape and signs. Slip/trip/fall hazards will be addressed through an ongoing proactive housekeeping program that eliminates elements in the work area that have potential for causing loss of footing.
Electrical shock	Mobilization, installation of wells, O&M of remediation system, and demobilization	All major electrical work (wiring, control panel construction, etc.) will be subcontracted to a qualified electrical contractor. GFCI will be used where appropriate. Care will be taken to de-energize and ground any electrical equipment prior to any necessary repair work. Before undertaking any repair work, the energy source will be either permanently disconnected or temporarily tagged and kept locked to prevent the equipment from accidentally energizing. Personnel performing repair work shall have been trained on LO/TO and will be responsible for complying with all applicable LO/TO procedures.
Flying particulate	Installation of extraction and injection wells	All site personnel will wear hard hats and safety glasses with side shields during drilling.
Objects striking head	Mobilization, installation of wells, and demobilization	Hard hats will be worn in the vicinity of overhead hazards (e.g., in the drilling rig area).
Explosion/Fire	All tasks	Open-flame ignition sources will be restricted from the work area (smoking, etc.). No smoking is permitted in the work zones. Any free-phase petroleum or gasoline will be stored in appropriate containers. Signs indicating flammable liquids will be posted where appropriate. Appropriate fire extinguishers will be available to site personnel during field activities.
Inhalation and contact of organic vapors	Installation of extraction and injection wells; sampling of wells and system ports	If conditions require upgrading to air-purifying respirations (Level C PPE), an addendum to this SHSP will be submitted for review and approval. Remain upwind whenever possible. Wear disposable gloves and safety glasses with side shields when handling soil and sampling waters.
Contact with detergent, samples, or solvent	Decontaminating sampling equipment	Level D PPE is typically adequate. Wear coveralls and gloves. Wear safety goggles when preparing and using decontamination solutions. Maintain good housekeeping. No eating, smoking, or drinking on-site.
Weather extremes	All tasks	Use dress consistent with conditions. Implement worker rotation and rest period schedules. Adjust work day to take advantage of the cooler parts of the day. Maintain periodic telephone communication between on-site and off-site personnel to ensure good physical condition of on-site personnel. Frequently consume water or an electrolytic beverage to prevent dehydration.

LO/TO = lockout/tagout.

3.1.2 Hazards Associated with Remediation System

The O&M of the remediation system has several associated hazards that will be mitigated using the following precautions:

- Electrical shock – All major electrical work (wiring, control panel maintenance, etc.) will be subcontracted to a qualified electrical contractor. GFCIs will be used where appropriate, e.g., in wet locations. Care will be taken to de-energize and ground any electrical equipment prior to any necessary repair work. Before undertaking any repair work, the energy source will be either permanently disconnected or temporarily tagged and kept locked to prevent the equipment from accidentally energizing. Personnel performing repair work shall have been trained on Lock Out/Tag Out (LO/TO) procedures as specified in the OSHA citation 29 CFR 1910.333 and will be responsible for complying with all applicable LO/TO procedures.

- Moving Parts – Before equipment is used, it will be inspected and tested and certified to be in safe working condition. All moving parts of the equipment will be guarded when exposed to contact by field personnel or when the equipment poses a hazard.

- Pressurized Lines – All pressurized equipment and systems will be maintained and operated in accordance with EM 385-1-1 Section 20 (USACE, 2003).

- Hot Surfaces – All field personnel will be advised of the potential for moving parts on the system which become hot during operation. Easily accessible surfaces will be labeled with a sign reading "Caution Hot Surface".

3.1.3 Hazards Associated with IDW Disposal

The main hazards associated with IDW disposal include contact with contaminated wastewater, detergents, and solvents. Disposal of potentially contaminated soil from drilling and well installation activities will be completed as described in the Sampling and Analysis Plan (SAP; Appendix C). During soil disposal activities, field personnel will wear proper Level D PPE. Any IDW and wastewater created under this effort will be disposed of off-site. During this process Level D PPE will be worn by field personnel to protect against contact with contaminated wastewater. All hazardous waste collected under this Task Order will be disposed of off-site in accordance with all applicable Federal, State and local regulations.

3.1.4 Hazards Associated with Well Installation

The main hazards associated with soil boring and groundwater monitoring well installation are listed in Table 1 and include electrical shock, flying particulates, objects striking head, and inhalation and contact of organic vapors.

Drilling equipment will be operated, inspected, and maintained according to manufacturers' operating manuals. Battelle will subcontract the drilling and installation of all wells at JPL. Battelle field personnel will be present during these activities to supervise and monitor the health and safety of field personnel.

Prior to the start of any drilling activities, a survey of the site will be completed. This survey will include all overhead hazards and any underground utilities or hazards. The survey results and maps will be used

to determine any previously unknown hazards; this information will be discussed in the Tailgate Meeting and will determine the location of extraction and injection wells.

3.2 Hazards Associated with Chemicals Substances at JPL

A list of the chemicals identified to be in the groundwater and their associated exposure limits are presented in Table 2. Table 2 lists the primary health hazards associated with each of these chemicals.

Table 2. Primary Health Hazards and Exposure Limits for Chemical Substances at JPL

Compound (CAS #)	PEL-TWA[(a)]	PEL-STEL[(a)]	TLV TWA[(b)]	TLV STEL[(b)]	Primary Health Hazard
Carbon tetrachloride (56-23-5)	10 ppm	25 ppm	5 ppm	10 ppm	Liver; cancer
1,1-Dichloroethylene (75-35-4)	—	—	5 ppm	—	Harmful if ingested, inhaled or absorbed through the skin; Reproductive; cancer
1,2-Dichloroethane (107-06-2)	50 ppm	100 ppm	10 ppm	—	Skin irritant; liver; cancer
Tetrachloroethene; PCE (127-18-4)	100 ppm	200 ppm	25 ppm	100 ppm	Irritation; CNS
Trichloroethene (79-01-6)	100 ppm	200 ppm	50 ppm	100 ppm	CNS; headache; liver
Perchlorates	NA	NA	NA	NA	Skin irritant; respiratory
Chromium (hexavalent) All forms all compounds	0.005 mg/ m^3	—	--	—	Respiratory, lung and stomach cancer.
Chromium (hexavalent) Inorganic, soluble compounds	--	--	0.05 mg/ m^3	--	Respiratory, lung and stomach cancer.
Chromium (hexavalent) Inorganic, insoluble compouunds	--	--	0.01 mg/ m^3	--	Respiratory, lung and stomach cancer.
Chromium (III) (7440-47-3)	0.5 mg/m^3	—	0.5 mg/ m^3	—	Irritation; dermatitis; liver; kidney; respiratory;
1,4-Dioxane (123-91-1)	100	—	20 ppm	—	Irritation; liver; kidney

PEL = permissible exposure limit
TWA = time-weighted average
STEL = short-term exposure limit
(a) 29 CFR 1910.1000 Table Z (OSHA Z Table).
(b) TLVs and BEIs (ACGIH, 2006).
NA = Not applicable.

3.2.1 Carbon Tetrachloride

Carbon tetrachloride (CCl_4) is a colorless liquid with a melting point of -23°C and a boiling point of 77 °C. Its vapor pressure is 91 mmHg at 20 °C. Carbon tetrachloride is classified as B2, a probable human carcinogen. Inhalation and ingestion of CCl_4 can be fatal. It is an irritant that could lead to dermatitis if

contacted with the skin. Kidney or liver damage may result from long-term use of carbon tetrachloride. It can also affect the central nervous system (CNS) and cause damage or cancer to the eyes, skin, and lungs. CCl_4 is incompatible with alkali metals, chemically active metals, strong oxidizing agents, allyl alcohol, fluorine, and strong bases. It should be kept away from heat and possible sources of ignnition due to potentially toxic decomposition products.

3.2.2 1,1-Dichloroethylene (1,1-DCE)

1,1-DCE is a colorless liquid at room temperature with a mild, sweet odor. Its boiling and melting points are 31.7 °C and –122.5°C, respectively. It has a vapor pressure of 591 mmHg at 25°C and density of 1.213 g/cm^3 at 20°C. The main use of 1,1-DCE is to produce copolymers such as polyvinylidene chloride, acrylonitrile, vinyl chloride, and methyacrylonitrile. The copolymers are used in flexible films, such as SARAN and VELON, and as a flame retardant for fiber, carpet backing and piping. They are also used in flexible packaging materials and as an adhesive.

1,1-DCE is classified as a group C carcinogen meaning it is a possible human carcinogen (Faust, 1993). Inhalation of 1,1-DCE at low levels over a long period of time can cause damage to the CNS, liver and lungs. High-level exposure health effects include loss of breath and fainting, effects on the CNS and death from hepatotoxicity and nephrotoxicity.

3.2.3 1,2-Dichloroethane (1,2-DCA)

1,2-DCA is a colorless, heavy and flammable liquid which evaporates quickly at room temperature and has a sweet odor and taste. Its vapor pressure at 25°C is 79.1 mmHg and density is 1.23 g/cm^3 at 20°C. Its melting and boiling points are –35.5°C and 83.5°C, respectively.

1,2-Dichloroethane is classified as group B2, which means it is a probable human carcinogen through the oral and inhalation routes (Opresko, 1994). The routes of exposure to humans are absorption through the lungs, gastrointestinal system and skin. It is distributed throughout the body, but concentrates in the adipose tissue and is generally excreted with soluble urinary metabolites. Some health effects caused by exposure to 1,2-DCA are bronchitis, central nervous system depression, dizziness, vomiting, partial paralysis, liver and kidney damage, hemorrhages throughout the body, and death (Opresko, 1994).

1,2-DCA is mainly used in the manufacturing of vinyl chloride and other compounds including PCE, TCE, and 1,1,1-trichloroethane. Other uses are as a solvent to degrease metals, as well as a fumigant and lead-scavenging agent in gasoline. It is also used in paints, coatings, adhesives, varnishes, finish removers, soaps, and scouring agents (Opresko, 1994).

3.2.4 Tetrachoroethene (PCE)

PCE is a nonflammable, colorless liquid at room temperature with a sweet odor. Its vapor pressure at 25°C is 18.47 mmHg and density is 1.6227 g/ml. Its melting and boiling points are –19°C and 121°C, respectively (ATSDR, 1997b). PCE is used as a solvent in dry-cleaning operations and for degreasing metals (ATSDR, 1997a). It is also used to dissolve greases, fats, waxes and oils without harming fibers. It is a chemical intermediate and has also been used to treat hookworm and some nematode infestations (ATSDR, 1997b).

Tetrachloroethene has been classified as group B2 to C, which means it is a possible to probable human carcinogen. PCE enters the body through the lungs and digestive tract, but not through the skin. Oral and inhalation exposure to PCE target the liver and kidney and the central nervous system is also affected by inhalation of PCE. Exposure to high concentrations can cause headache, nausea, sleepiness, difficulty

speaking and walking, dizziness, confusion, unconsciousness, and death. Some women have also experienced menstrual problems and spontaneous abortion when exposed to PCE (Daugherty, 1993).

3.2.5 Trichloroethene (TCE)

TCE is a nonflammable, colorless liquid at room temperature which has a sweet odor and evaporates easily. Its vapor pressure at 25°C is 74 mmHg and density at 20°C is 1.465 g/ml. Its melting and boiling points are –87.1°C and 86.7°C, respectively. Currently, TCE is primarily used as a solvent to degrease metals and for fats, waxes, resins and oils (Faust, 1993). It is used in the manufacturing of other chemicals. It can also be found in paint removers, spot removers, adhesives, and typewriter correction fluid. It was once used as an anesthetic, fumigant, disinfectant and to extract caffeine from coffee (Faust, 1993). Production of TCE naturally occurs from marine macroalgae and microalgae.

TCE is classified in group 2A, which means it is a probable human carcinogen. Humans are exposed to TCE through oral, inhalation and dermal routes. The primary target organs are the liver, kidney, central nervous system, cardiovascular system, hematopoietic system, and reproduction. Some health effects of TCE include headaches, dizziness, poor concentration, impaired heart function, unconsciousness, nerve, kidney and liver damage, and death (Faust, 1993).

3.2.6 Perchlorate

Perchlorate (ClO_4^-) is the most oxygenated member in a series of four anions made up of chlorine and oxygen (OEHHA, 2002). The anion has a charge of negative one, and can form an acid or salt in combination with H^+ or another cation such as sodium, potassium, or ammonium ion (OEHHA, 2002). Perchlorate salts dissociate completely in water. Ammonium perchlorate (NH_4ClO_4) is a white, crystalline solid used as an oxidizer in rocket propellant fuel. Perchlorate salts are also used in explosives, pyrotechnics and flares, in tanning and finishing leather, as a mordant for fabrics and dyes, and in electroplating, aluminum refining, rubber manufacture, and the production of paints and enamels (Hazardous Substances Database [HSDB], 2002; OEHHA, 2002).

Potassium perchlorate was used in the late 1950s and 1960s as an antithyroid agent in the treatment of hyperthyroidism (i.e., Graves' disease) until reports of severe hematological effects occurred. European physicians began using it again in the 1980s as long as the dose remained below 1,000 mg/day. A serious human health effect is the disruption of thyroid hormone production because perchlorate blocks the transport of iodine to the thyroid gland. Two hormones, triiodothyronine (T3), and thyroxine (T4), help regulate the body's metabolism and physical growth. When blockage occurs, the thyroid's iodide reserves are reduced, thus decreasing production of T3 and T4. When levels of T3 and T4 decrease, the pituitary gland and the hypothalamus gland, which regulate thyroid hormones, increase their own hormone production to compensate for the low levels of T3 and T4. Too much or too little thyroid hormone can lead to disease (OEHHA, 2002). Perchlorate can cross the placenta, thus affecting a developing fetus. For children in utero and up to three years of age, thyroid hormone is critical to normal brain and physical development.

3.2.7 Hexavalent Chromium

The properties of hexavalent chromium vary with the different compounds. It is a solid at room temperature and is typically orange, red or yellow in color. Hexavalent chromium is generally soluble in water; however, the degree of solubility is dependent on the compound. For example, the solubility of lead chromate is 5.8 µg/L and sodium dichromate has a solubility of 230 g/100 cc at 0°C. Zinc chromate, on the other hand, is insoluble in water. Melting and boiling points also vary widely among the compounds. Some compounds decompose at temperatures between 170°C and 500°C (ASTDR, 2000).

The use of hexavalent chromium can be found in many industries including chrome plating, electroplating, stainless steel welding, leather tanning, wood preserving and chemical manufacturing (ATSDR, 2000). It is used to make stainless and heat resisting steel, astringents and antiseptics, dyes and pigments, batteries, candles, paints, rubber and cement and for corrosion resistance, high temperature research, and industrial water treatment (USDHH, 2001; ASTDR, 2000).

Hexavalent chromium enters the body through inhalation, ingestion and dermal contact. Exposure to chromium can cause nosebleeds, ulcers and holes in the nasal septum, upset stomach, ulcers, kidney, liver and lower respiratory tract damage, gastrointestinal irritation, dizziness, headaches, burns on the skin, blisters, skin ulcers, labored breathing, cancer and death (ATSDR, 2000). Chromium (VI) is classified in group A, which means it is a known human carcinogen. Exposure to hexavalent chromium usually causes respiratory system, lung or stomach cancer (ATSDR, 2000).

3.2.8 Trivalent Chromium

The properties of trivalent chromium vary among the different chromium compounds. The color varies from blue-green to purple to brown or black. It is a solid at room temperature with a melting point between 60°C (for chromium (III) nitrate) and 2,266°C (chromium (III) oxide). At high temperatures, chromium compounds decompose (e.g. chromium (III) nitrate at 100°C), sublime (e.g. chromium (III) chloride at 1300°C), or boil (e.g. chromium (III) oxide at 4,000°C). Trivalent chromium compounds are primarily insoluble, but some compounds are soluble or slightly soluble (ATSDR, 2000).

Trivalent chromium is used in the production of metals and alloys, as brick lining for high-temperature furnaces, in manufacturing chemicals, for chrome plating, leather tanning, wood preserving, and in dyes and pigments (ATSDR, 2000). It generally enters the atmosphere through emissions from coal and oil burning or steel production (ATSDR, 2000). Atmospheric fallout and precipitation are the primary means of removing trivalent chromium from the atmosphere. In water, trivalent chromium is precipitated and then buried in sediment. In soil, it is transported by runoff or as dust (U.S. EPA, 1998).

Trivalent chromium is classified in group D which means it is not classified as a human carcinogen (U.S. EPA, 1998). Trivalent chromium can enter the body through inhalation, ingestion and dermal contact. The body does not generally absorb large amounts of trivalent chromium (Daughtery, 1992). Health effects caused by exposure to trivalent chromium include coughing, wheezing, asthma, and inhibits DNA replication.

3.2.9 1,4-Dioxane

1,4-Dioxane is a colorless, flammable liquid at room temperature and has a pleasant odor. It has boiling and melting points of 101.5°C and 11.8°C, respectively (OEHHA, 2002) Its vapor pressure is 30 mmHg at 20°C (U.S. EPA, 2002). 1,4-Dioxane is miscible with water, aromatic solvents and oils (OEHHA, 2002).

Uses of 1,4-Dioxane include a degreasing agent, a component of paint and varnish removers, and a wetting and dispersion agent in the textile industry. It is also used as a solvent in chemical synthesis, a fluid for scintillation counting, and a dehydrating agent in the preparation of tissue sections of histology (OEHHA, 2002). It is a solvent for cellulose acetate, ethyl cellulose, benzyl cellulose, resins, oils, waxes, dyes, and other organic and inorganic compounds (U.S. EPA, 2002). It is also a solvent for specific applications in biological procedures and a stabilizer for chlorinated solvents such as 1,1,1-trichloroethane. It is a reagent for laboratory research and testing. In the past it was used as a solvent in coatings, sealants, adhesives, cosmetics and pharmaceuticals (USDHH, 2001).

1,4-Dioxane is classified as group B2 which means it is a probable human carcinogen. Exposure to 1,4-Dioxane is generally from inhalation, ingestion or dermal contact. It is very mobile in the environment due to its volatility and solubility in water. 1,4-Dioxane may cause drowsiness, vertigo, headache, irritation of the eyes, nose, throat, lungs and skin, nausea, vomiting, hepatic and renal lesions, coma, or death (U.S. EPA, 2002). The target organs used to determine the hazard index are the alimentary system, kidney, and circulatory system (OEHHA, 2002).

3.3 Physical Hazards

3.3.1 Flammability/Explosive Nature

It is unlikely that explosive atmospheres will be encountered during remedial activities. However, the following standard safety procedures will be implemented:

- All field vehicles and heavy equipment will be equipped with type-ABC fire extinguishers. Fire extinguishers will be mounted on vehicles where field personnel can easily access them. A fire extinguisher check, including inspecting gauges, hoses, and tanks, must be completed monthly to verify proper condition of the equipment. An annual maintenance check on each fire extinguisher must be conducted and documented.

- When necessary, a fire watch and fire extinguisher or other fire-fighting equipment should be made available.

- Open fires and burning are prohibited. Smoking will be prohibited in all areas where flammable, combustible, or oxidizing materials are stored or in use.

The following procedures should be implemented for refueling of vehicles:

- Refuel only in pre-designated outdoor areas.
- Shut off vehicle engines when not in use.
- No smoking is allowed.
- Do not over-fill fuel tanks.

The following apply to the storage and dispensing of flammable materials:

- All tanks containing flammables should be labeled with the contents in 4-inch-high letters.
- All flammable chemicals should be stored in flammable-chemical storage cabinets.
- Oxygen should be stored at least 25 feet from combustible liquids, flammable materials, heat sources, or in an area with a fire barrier having a ½ hour rating.
- Oxygen storage areas should be vented.

3.3.2 Hazards Associated with Heavy Equipment

The hazards associated with the operation of heavy equipment can be effectively managed through adequate training and constant awareness. Consistent visual or verbal contact with the equipment operator will facilitate such awareness. All mobile equipment operators will have had the required training and should demonstrate the necessary skills to operate heavy equipment. Mobile equipment will not obstruct roadways, walkways, electrical lines, etc. Proper distance from overhead power lines should be observed. All personnel working around heavy equipment will wear hard hats, safety-toed boots, and orange vests.

3.3.3 Slip/Trip/Fall Hazards

While it is difficult to prevent slip/trip/fall hazards, these hazards can be minimized through use of appropriate footwear, good housekeeping, proper site control measures and keeping the work area free of obstructions. Personnel will be required to perform fieldwork in pairs (buddy system) so that immediate assistance will be available should a slip/trip/fall occur. Slip/trip/fall hazards will be addressed through an ongoing proactive housekeeping program that eliminates elements in the work area that have potential for causing substantial loss of footing.

3.3.4 Lifting Hazards

Field operations often require that physical labor tasks be performed. All employees should employ proper lifting procedures. Additionally, employees should not attempt to lift bulky or heavy objects (over 40 pounds) without assistance.

3.3.5 Tool and Equipment Hazards

Hazards present while using tools and equipment are generally associated with improper tool handling and inadequate maintenance. Management of these hazards requires a rigorous maintenance of tools and equipment and effective training of employees in the proper use of these tools. Electrically powered tools have inherent physical hazards. Hand-held power tools, including jackhammers, should be held firmly. This equipment will create vibrations during operation. Proper safety procedures will be implemented during their operation.

Electrical cords should have unbroken insulation and should not be exposed to water or other liquids. A ground fault circuit interrupter (GFCI) outlet or cord must be used in any area where water may be present. Large power tools and equipment should be lifted properly to prevent back injuries.

Safety glasses with side shields, ear protection, and safety-toed boots will be worn while operating powered tools or equipment.

3.3.6 Heat Stress Hazards

Work under this project may be required in hot environments depending on the time of year. During hot or humid days, or during the performance of strenuous work, extra precautions will be necessary to reduce the potential for heat stress. Implementation of worker rotation and rest period schedules and adjustment of the workday to take advantage of the cooler parts of the day may be used to prevent exposure to heat stress hazards. Whenever possible, shade will be utilized or provided to field personnel to help mitigate heat stress hazards. Any adjustments to workday schedules that deviate from normal business hours will be cleared with the appropriate personnel. Also, frequent consumption of water or an electrolytic beverage is necessary to prevent dehydration (drink about 16 ounces before starting work, and

5 to 7 ounces every 15 to 20 minutes while working). The levels of heat stress are characterized in Table 3.

Factors which increase the risk of heat induced problems:

- High physical exertion.
- Being unaccustomed to working in heat.
- Wearing protective clothing that traps body heat.
- Age (older people may have less body water and lower sweat gland efficiency).
- Being overweight, which makes the body work harder to perform tasks.
- Medications that can interfere with normal body reactions to heat.

Table 3. Signs and Symptoms of Heat Related Illnesses and Treatments

Heat Induced Problems			
Problem	**Body Response**	**Signs and Symptoms**	**Treatment**
Heat Cramps	• The body loses too much salt from heavy exertion in heat.	• Painful spasms of muscles used during work.	• Increase fluid intake with electrolytes (Unless otherwise indicated by a doctor). • Take frequent breaks, preferably in a cool area.
Heat Exhaustion	• The body can't replace fluids and/or salt lost in sweating. • Perspiration in heat is important because it cools the body as it evaporates.	• Weakness, dizziness, nausea. • Pale or flushed appearance. • Sweating, moist and clammy skin.	• Move to a cool place. • Loosen clothes and apply cool compresses. • Drink water slowly. • Elevate feet 8-12 inches.
Heat Stroke	• The body no longer sweats and holds so much heat that body temperature reaches dangerous levels. • **Heat stroke is a medical EMERGENCY and can lead to delirium, convulsions, unconsciousness, or death.**	• DRY, hot reddish skin, and LACK OF SWEATING! • High body temperature and strong, rapid pulse. • Chills • Confusion	• **Treat as a MEDICAL EMERGENCY!** • Call for EMS or a doctor immediately! • Move to a cool area immediately. • Use cool water to soak person's clothes and body. • Fan the body. • Don't give fluids if victim is unconscious.

EMS = Emergency Medical Services

3.3.7 General Site Safety

The following PPE and clothing will be used during field sampling activities:

- Safety-toed boots.
- Goggles or safety glasses with side shields.
- Standard work clothing or chemical resistant Tyvek® coveralls.
- Nitrile or equivalent laboratory/exam gloves.
- Hearing protection.

Hard hats, hearing protection, and other PPEs listed above are required during drilling operations at JPL.

3.4 Biological Hazards

There are several biological hazards to which personnel may be exposed while performing work at the NASA JPL site. These hazards may include snake bites (a variety of snakes are present at JPL, but not all are poisonous), insect bites (i.e., mosquitoes, deer flies, chiggers, and ticks) and stings (i.e., bees, wasps) and exposure to pathogenic (disease producing) microorganisms. Animal and bird droppings often contain mold, fungus, bacteria or viruses that represent a significant respiratory hazard. If encountered, personnel will be instructed to avoid touching droppings.

Paramedics will be summoned for serious injuries. First aid procedures for biological hazards will follow the program set up by the American Red Cross.

4.1 Work Area Control

Proximity to field activities will be limited to reduce the probability of occurrence of physical injury and chemical exposure of field personnel, visitors, and the public.

Work area control will be achieved through the use of zones (exclusion zone, contamination reduction zone, and support zone). All three zones will be established for drilling and well installation activities, but for the O&M of the remediation system, there will only be a designated exclusion zone which will be surrounded by a locked, fenced area. The area outside of the exclusion zone will be considered the support zone. Access to the remediation system will be limited to authorized personnel only. No contamination reduction zone is required because no hazardous chemicals will be used during O&M.

During field activities, the equipment will be oriented to minimize impact to surrounding vehicles, buildings, and military operations. The area surrounding each extraction and injection well and recovery equipment will be the exclusion zone. Non-project personnel will be directed away from the immediate area of the drill rig. The area outside of the exclusion/contaminant reduction zone will be considered the support zone. The first aid kit will be kept in the support zone.

The three work area control zones for the construction of new wells and soil boring will be similar to the control zones used at the remediation system. The area immediately surrounding the hollow-stem auger (HSA) drill rig will be designated the exclusion zone. The exclusion zone and contamination reduction zone will be designated with traffic cones and/or caution tape. Soil samples collected during drilling will be processed in the exclusion zone. The decontamination of drilling equipment using a portable decontamination trailer will be performed in the contamination reduction zone.

4.2 Decontamination Control

All nondisposable field equipment will be decontaminated before each use and between samples to avoid cross-contamination between samples and to ensure the health and safety of the field crews. The decontamination procedure for each task will be specified in the SAP. Areas for decontamination will be coordinated with the appropriate NASA JPL personnel before sample collections begin. Drilling equipment will be decontaminated by hot pressure washing. Decontamination of drilling equipment will be performed in a portable decontamination trailer. All other nondisposable sampling equipment and PPE will be decontaminated by washing with a phosphate-free detergent solution or by steam cleaning. All decontamination water will be collected in approved 55-gallon drums or a poly-tank and will be transported off-site for disposal within 90 days.

In general, the following decontamination procedure will be used for nondisposable sampling equipment and PPE:

1. Set up a sampling equipment decontamination/wash area. Fill three containers (e.g., 5-gallon buckets) with tap water and one container with deionized water. Add Liquinox™ or an equivalent phosphate-free detergent to one of the tap water containers according to the manufacturer's directions. Align the containers in the following manner: Tap water, detergent solution, tap water, deionized water.

2. In the first container of tap water, rinse the item to remove as much soil, water, contamination, etc., as possible. Change this water frequently.

3. In the second container of detergent solution, wash the item using a scrub brush or other suitable cleaning tool. Discard this wash water and create a new detergent solution when necessary.

4. In the third tap water container, rinse the item to remove any traces of detergent. Change this water frequently.

5. Rinse the item in the container with deionized water to remove any remaining traces of detergent or tap water.

Decontamination procedures for groundwater sampling are described in the SAP.

5.0 PERSONNEL PROTECTION

The possibility of exposure to chemicals in soil and groundwater presents a minimal potential health risk to site workers and proximate base personnel. Installation and O&M of the remediation system present a minimal opportunity to contact contaminants of concern in high concentrations. The primary personal protective clothing used will be disposable nitrile gloves and safety glasses with ridgid side sheilds. If necessary, based on the exposure limits listed in Table 2, respiratory protection and engineering or work-practice controls will be used to minimize exposure and to protect workers and JPL personnel. The level of protection to be utilized throughout the duration of this Task Order will be EPA Level D, as based on known contaminant levels and previous work performed at the JPL. It is the responsibility of the field personnel to inspect all PPE prior to use. Evaluation of the effectiveness of the Battelle PPE program will be examined by the SHSO following the guidelines established in the Battelle PPE Program Manual (Battelle, 2004).

5.1 EPA Levels of Protection

There are four levels of EPA-mandated personnel protection: Levels A, B, C and D. Levels A, B, and C are not anticipated for this task order. If site conditions change and a higher degree of protection is required, the SHSO will consult the HSO/CIH and the required changes in PPE with be made. A change in the level of PPE will result in this SHSP being amended and reviewed by the HSO/CIH.

Level D protection will consist of the basic work clothing, plus the following depending on activities to be performed:

- Hard hat
- Coveralls/standard work clothing
- Safety glasses with protective side shields
- Safety-toed boots
- Nitrile gloves (or equivalent)
- Available hearing protection
- Available protection against ultraviolet (UV) rays (i.e. sun block, hats, or long sleeves).
- For emergency purposes or in the event of PPE upgrade, an available half-face or full-face, air purifying respirator with National Institute for Occupational Safety and Health (NIOSH) approved combination organic vapor/acid gases/P-100 cartridges (yellow/magenta)*

*All personnel who may be required to wear a respirator will be enrolled in an employer medical surveillance and respiratory protection program and have their assigned respirator fit-tested before wearing it on the project.

5.2 Air Monitoring Procedures

Screening for the presence of volatile organic compounds (VOCs) while conducting fieldwork is generally done with a handheld photoionization detector (PID) or flame ionization detector (FID). During

drilling, breathing zone readings will be taken periodically (approximately every 15 minutes), unless the SHSO determines that more frequent monitoring is required. Field personnel will perform a daily calibration of the PID/FID and operate the instrument according to the manufacturer's instructions. Air monitoring results will be compared to the action levels identified in Table 2. The appropriate PPE will be selected based on the contaminant concentrations encountered during air monitoring. The daily air monitoring results and calibration information will be recorded on the Air Monitoring Data Sheet (Attachment 1). Air monitoring will accomplish the following tasks:

1. Ensure that proper PPE, work practices, and engineering controls are being used at the site;

2. Ensure that site personnel are not exposed to concentrations of hydrocarbon compounds exceeding the PELs; and

3. Quantify the concentrations of ionizable hydrocarbon compounds at the wellhead and the workers' breathing zone.

6.1 Recommended Equipment Safety Guidelines

Equipment maintenance and safety is the responsibility of the operator. The following information is provided as general guidelines for safe site practices:

- Inspect the route of travel before moving equipment off-road. Note rocks, trees, erosion, and uneven surfaces.
- Approach changes in grade squarely to avoid shifting loads or unexpected unweighting.
- Use a spotter (person at grade) to provide guidance when vertical and lateral clearance is questionable.
- Locate overhead and buried utilities prior to removal operations. Treat overhead electrical lines as if they were energized.
- Contact the appropriate utility agencies to deactivate overhead or underground services that may interfere with sampling operations. Only authorized and trained personnel should attempt to handle utilities.
- Note wind speed and direction to prevent unshielded overhead utility lines from contacting equipment.
- Allow at least 20 feet of clearance from overhead utility lines.
- Contact appropriate utility agencies to survey, mark, and flag locations of buried utility lines.
- Maintain orderly housekeeping of the remediation system.
- Store tools, materials, and supplies properly and in a secure area.
- Maintain working surfaces free of obstructions or potentially hazardous substances.
- Store gasoline in approved safety containers only.

6.2 General Safety During System Installation

Personnel must wear prescribed PPE, as appropriate, during recovery activities. Contamination avoidance should be practiced at all times. Personnel must employ the "buddy system" at all times and maintain communication with each other. In some situations, such as work in isolated locations, additional monitoring may be needed to establish the proper level of protection before the sampling team can proceed. Personnel responsible for operating the remediation system will wear Level D PPE protection.

6.3 General Safety During System O&M

O&M of the groundwater remediation system will only be conducted by fully trained/qualified field personnel. Any mechanical hazards will be identified at initial start up and measures will be taken to

mitigate the hazards. Remaining hazards will be clearly marked and all field personnel will be notified of safety precautions to use while the systems are in operation.

6.4 Decontamination Safety

Decontamination procedures can pose hazards under certain circumstances, particularly when chemical decontamination solutions are used. Most of the equipment used on-site will be decontaminated by washing, or a series of washings, followed by a series of rinses using generous amounts of deionized (DI) water (see Section 4.2). Exposure to hazardous materials and decontamination solutions will be controlled by the use of appropriate personal protective clothing and accessories, which includes safety glasses, faceshields (during power washing or steam cleaning), nitrile gloves, and safety-toed boots. MSDS information for methanol (methyl alcohol) and Liquinox™ are provided in Attachment 2. Decontamination of equipment by steam cleaning will be done away from general personnel.

7.1 Communication

A communication program will be implemented during the project. Workers are to use the buddy system at all times and be cognizant of the reduction of communication abilities in high-noise areas. The specific hand signals to be used during the project will be discussed in the tailgate safety meeting and will include, but are not limited to, the following:

- Closed fist – Stop work
- Hand crossed above head – Personal injury
- Hand gripping throat – Cannot talk; Having difficulty breathing
- Grip partner's wrist – Cannot talk; Leave area immediately
- Hands on top of head – Need assistance
- Thumbs up – OK, I am all right, I understand
- Thumbs down – No, negative

7.2 Site Evacuation Procedures

In case of an emergency, an air horn, or an equivalent device that can generate at least 80 dBA of noise, will be used as the evacuation warning. One long blast from the horn will be understood to mean immediate evacuation from the exclusion zone. Personnel working on the site will immediately make their way to the designated gathering point for a "head count". The gathering point will be site and activity dependent and therefore will vary. The SHSO will determine the gathering point and notify all site personnel at the daily tailgate meeting.

In the event that an emergency requires the evacuation from the JPL, the parking lot of the Huntington Memorial Hospital will be the designated emergency gathering location. The route to the hospital is presented in Figure 1. Driving distance is approximately 2.4 miles with an approximate travel time of six minutes. The emergency evacuation plan will be discussed in the first pre-entry tailgate meeting and as necessary when new personnel arrive on-site.

7.3 First Aid

A fire extinguisher and a first aid kit, containing the American Red Cross first aid manual, will be stationed in each field vehicle. A blood-borne pathogen clean-up kit will also be available. This kit will consist of, as a minimum, household bleach, empty spray bottle, disposable gloves, disposable towels, red biohazard disposal bags. The following personnel are trained in first aid, CPR, and blood borne pathogens:

- Dave Clexton, SHSO
- Ben Headington, SHSO
- Linc Remmert, HSO

JPL's Medical/Fire Service Station is located on-site and can be reached by dialing 3-3333 from any on-site telephone.

If an injured individual requires further attention, the individual will be immediately transported to the nearest hospital. A map illustrating the route to the off-base emergency medical facility is presented in Figure 1. If necessary, the victim will be decontaminated prior to transport to the facility; if the injury is serious, decontamination is of secondary importance. A copy of this SHSP will accompany the injured workers to the medical facility. All accidents, without regard to severity, will be documented by the SHSO on the Accident/Incident Analysis Form (Attachment 1). The Accident/ Incident Form will be forwarded to the HSO and Project Manager within 24 hours. An analysis of the accident will be conducted by the HSO/CIH following the guidelines in the *Battelle Safety and Industrial Hygiene Manual* (Battelle, 2005d).

General first aid procedures are outlined below:

- **Skin Contact**: Use copious amounts of soap and water. Wash/rinse affected area thoroughly, then provide appropriate medical attention. An eyewash station and an emergency shower or drench system will be located in the contamination reduction zone and/or support zone as appropriate. Eyes should be rinsed for 15 minutes upon chemical contact.

- **Inhalation**: Move to fresh air and, if necessary, decontaminate and transport to hospital. Any loss of consciousness or exposure to airborne toxic substances, even if the individual appears to have fully recovered, will require immediate treatment by a qualified physician.

- **Ingestion**: Notify Poison Control Center and emergency medical facility and transport to nearest emergency medical facility immediately.

- **Puncture Wound or Laceration**: Decontaminate and transport to emergency medical facility. Apply direct compression to stop or slow the flow of blood.

- **Biological Hazard**: Identify the specific animal responsible for the injury (if possible), notify the nearest emergency medical facility and transport the affected worker immediately.

7.4 Decontamination During Medical Emergencies

If emergency first aid and/or medical treatment are required, decontamination procedures may be limited or omitted. If the contamination does not present a hazard to the rescue personnel, life-saving care may be instituted immediately. If contamination will present a risk to rescue personnel, minimal decontamination should be performed to allow initiation of aid. If contamination presents a significant risk to rescue personnel, then decontamination will need to be performed until the contamination no longer poses a risk.

Medical personnel should be notified prior to transporting the victim if the victim may be contaminated. Assurance must be made that the medical personnel at the receiving area are able and willing to handle a victim who is contaminated. Site personnel will accompany contaminated victims to the medical facility to advise on matters involving decontamination. A copy of this SHSP including applicable MSDSs will be brought along with the victim.

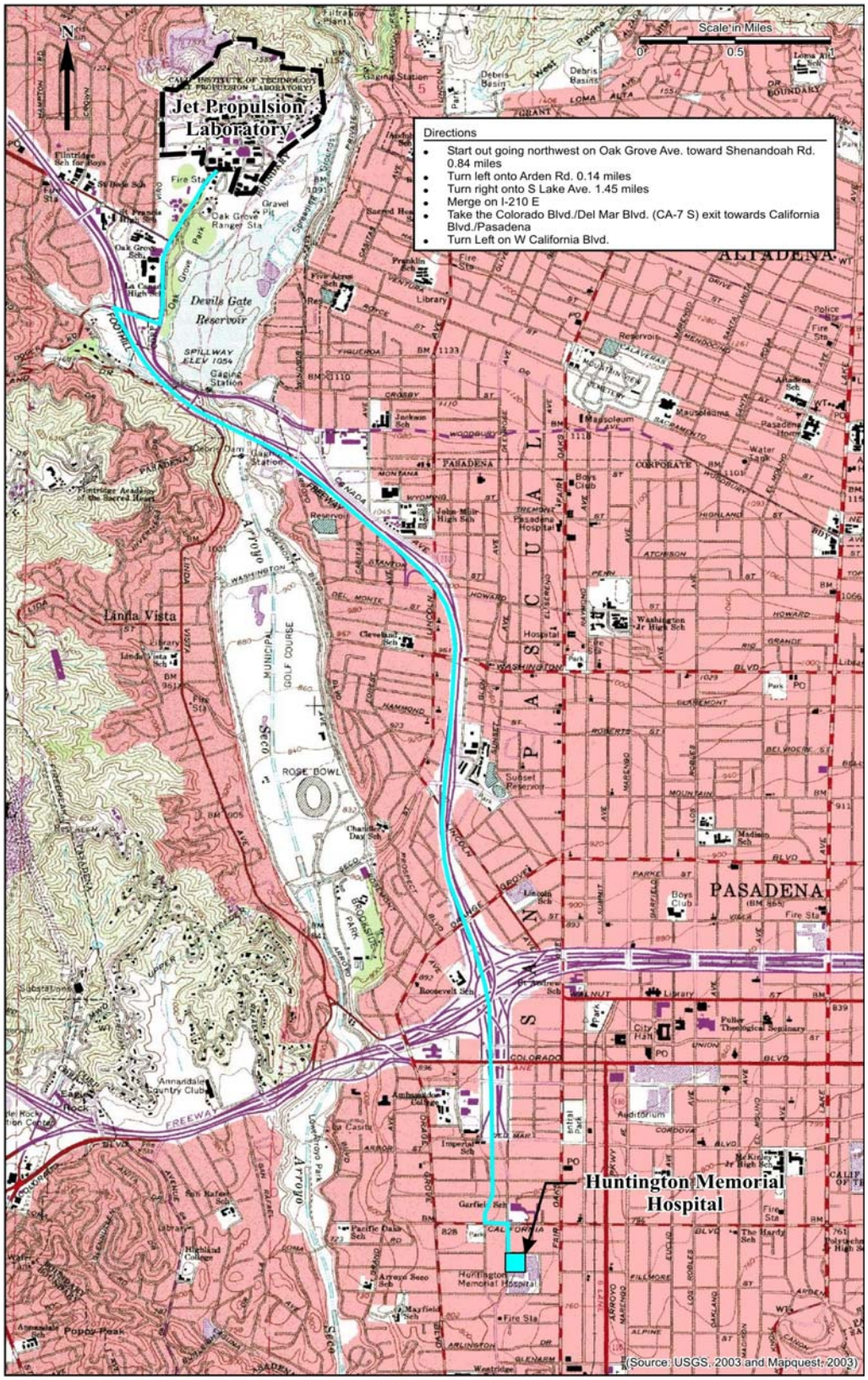

Figure 1. Hospital Location Map and Site Evacuation Route

Heat-related illnesses range from heat fatigue to heat stroke. Heat stroke requires prompt treatment to prevent irreversible damage or death. Protective clothing must be promptly removed. Less serious forms of heat stress also require prompt attention. Hazards associated with cold stress are not anticipated due to the project's geographic location.

Decontamination may be omitted or minimized and treatment begun immediately, unless the victim is obviously grossly contaminated. Only a qualified physician is allowed to treat inhalation exposure cases. If the contaminant has entered through the skin or the eyes, an emergency shower will be used for at least 15 minutes to rinse the affected area with water.

7.5 Emergency Assistance

The name, telephone number, and location of police, fire, and other emergency response agencies will be posted in the support zone. If emergency personnel are called to the site, efforts will be made to accommodate their safety operations.

Emergency Services

Ambulance	911
Fire Department	911
Highway Patrol	911
Police	911
Poison Control Center	(800) 222-1222
Dept. of Environmental Health Services	(800) 258-6942
National Response Center, Toxic Chemicals and Oil Spills	(800) 424-8802
NASA-JPL Security Fire/Medical Service	3-3333 (on-site telephones only)
NASA Security and Safety Officer	(818) 354-6053

Medical Centers

Huntington Memorial Hospital 100 W California Blvd. Pasadena, CA 91105-3010	(626) 397-5000
Verdugo Hills Hospital 1812 Verdugo Blvd Glendale, CA 91208-1407	(818) 790-7100

Battelle Personnel

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NASA JPL Field Office:	Phone: (626) 345-0598 Fax: (626) 345-0698

8.0 SPILL AND DISCHARGE CONTROL

Spill and Discharge Control has been developed to prevent the contamination of soils, water, uncontaminated areas/surfaces, equipment or material by the unauthorized release of a hazardous substance or material. The California EPA Office of Emergency Services will be notified immediately of any spills or releases at (800) 260-3972.

The following spill control equipment will be made available at all times:

- Clay, kitty litter, or other appropriate spill absorbent material.
- 55-gallon drums.
- Shovels.
- Decontamination supplies and protective clothing.
- Eyewash station.

Regardless of the type of spill (liquid or solid), the following measures will be taken to isolate the spilled material(s):

- Isolate and contain the hazardous spill area.
- Restrict access of unauthorized personnel.
- Prevent contact with the spilled material.
- Relocate upwind and upgradient of the spilled material.

9.0 MEDICAL SURVEILLANCE

Battelle's Medical Surveillance Program is based on the requirements outlined in 29 CFR 1910.120 and 1910.1030.

9.1 Contents of Medical Examination

All Battelle and subcontractor project personnel working on-site will have undergone either a baseline or annual medical monitoring examination within 12 months prior to participation in fieldwork.

Medical screening is conducted prior to employment and annually thereafter, and consists of the following:

- Medical and occupational history
- Physical examination, with particular attention to the cardiopulmonary system, general physical fitness, skin, blood forming, hepatic, renal, and nervous systems:
  - Urinalysis
  - Blood analysis
  - Pulmonary function test.
- Additional tests, including:
  - Audiometric test
  - Vision test.

Medical approval is required for personnel who need to wear respiratory protection equipment. During the annual physical, the medical evaluator will determine an individual's physical fitness for respirator usage. Based on this examination, the physician will certify in writing whether the individual is capable of full participation in the program, or whether that person must work within certain restrictions. Personnel may be excluded from this project for medical reasons. Any person suffering a lost-time injury or illness must have medical approval prior to returning to work.

9.2 Record Keeping

All medical records must be maintained by the employer for a period of at least 30 years after the employee's termination of employment, in accordance with OSHA regulations on confidentially and record keeping.

Prior to the initiation of work, subcontractors will submit to Battelle HSO/CIH copies of medical fitness certifications for each employee to be assigned to the site. The certifications will state that the employee has received a medical examination within the previous 12 months and has been determined fit to perform on-site work.

10.0 TRAINING

As required by OSHA regulations (29 CFR 1910.120), all Battelle and subcontractor personnel involved in hazardous waste site operations are required to receive an initial 40 hours of health and safety training and receive refresher training annually. All site personnel will complete this general (not site-specific) training before assignment to the project. Battelle is responsible and accountable for ensuring that Battelle staff are trained and qualified to carry out their assigned responsibilities on this project.

In addition, the on-site management, supervisors and the SHSO will receive additional specialized hazardous waste operations management training. This training will include, but shall not be limited to, the following:

- The employer's Health and Safety program.
- Hazard Communication Program.
- Associated employee-training program.
- PPE program.
- Spill containment program.
- Health hazard monitoring procedures and techniques.
- CPR/First Aid Training and blood borne pathogens control.
- Fire Extinguisher Training.

The HSO or the SHSO will keep copies of the certification for the completion of all training for all site workers on-site in a file. Workers without such certification will not be allowed to work at the site. Prior to commencement of field operations at the project site, personnel will receive site-specific training (briefed in the tailgate safety meeting), this training will include a review of all information contained in this SHSP with particular emphasis on the following:

- Types and anticipated levels of hazardous substances known to be present on-site, their PELs, health effects, and exposure routes.
- The need for PPE.
- The importance of maintenance and attention to proper fit of PPE.
- Prescribed decontamination procedures.
- Safe work practices, such as proper site entry and egress, and proper hygiene during meal and rest breaks.
- Recognition, in oneself and others, of physical conditions requiring immediate medical attention, especially heat stress, and simple first aid application measures.
- Procedures to be followed in case of emergencies.

In addition to the 40-hour training, Battelle personnel involved in the field operations will have had at least three (3) days of supervised field experience, on similar kinds of projects.

11.0 ADVERSE WEATHER CONDITIONS

In case of adverse weather conditions, the Project Manager or SHSO will determine if work can continue without endangering the health and safety of the field workers. The SHSO will monitor the weather during the morning and afternoon hours and will document it in the field logbook. A battery-operated weather radio will be kept on-site.

Some of the items to be considered prior to determining the continuance of work are:

- Potential for heat/cold stress and heat/cold-related injuries.
- Dangerous weather-related working conditions (high winds, dust storms).
- Limited visibility.
- Potential for electrical storms/thunder lightening. No outdoor activities will be permitted during electrical storms.

12.0 REFERENCES

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Daugherty, M.L. 1993. Toxicity Summary for Tetrachloroethylene. Chemical Hazard Evaluation Group, Biomedical Environmental Information Analysis Section, Health and Safety Division, Oak Ridge National Laboratory.

Faust, R.A. 1993. Toxicity Summary for Trichloroethene. Chemical Hazard Evaluation Group, Biomedical Environmental Information Analysis Section, Health and Safety Research Division, Oak Ridge National Laboratory.

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Office of Environmental Health Hazard Assessment. Draft Public Health Goal for Perchlorate in Drinking Water. Prepared by OEHHA California EPA. March.

Opresko, D.M. 1994. Toxicity Summary for 1,2-Dichloroethane. Chemical Hazard Evaluation Group, Biomedical and Environmental Information Analysis Section, Health Sciences Research Division, Oak Ridge National Laboratory.

RAIS. See Risk Assessment Information System.

USDHH. 2001. Ninth Report on Carcinogens. Chromium Hexavalent Compounds. U.S Department of Health and Human Services. Public Health Service.

United States Army Corps of Engineers. 2003. Safety & Health Requirements Manual, 385-1-1. November.

United States Environmental Protection Agency. 1992. U.S. EPA, Office of Emergency and Remedial Response, *Standard Operating Safety Guides*. OSWER Directive 9285.1-01B, U.S. Government Printing Office, Washington, D.C. June.

United States Navy. 2001. Navy/Marine Corps Installation Restoration Manual, Revised April.

USACE. See United States Army Corps of Engineers.

U.S. EPA. See United State Environmental Protection Agency.

U.S. Navy. See United States Navy.

U.S. EPA. 2002. Perchlorate Environmental Contamination: Toxicological Review and Risk Characterization. External Review Draft. Office of Research and Development. NCEA-1-0503. January 16.

ATTACHMENT 1

HEALTH AND SAFETY FORMS

SAFETY COMPLIANCE AGREEMENT FORM

Site: _____

Contract No. _____

Project No. _____

SHSO: _____

I acknowledge that I have read the information in this Health and Safety Plan. I understand the site hazards as described and agree to comply with the contents of the plan.

Signature & Printed Name	Company	Date

TAILGATE SAFETY MEETING FORM

Date: _____ Time: _____ Job Number: _____

Client: _____ Address: _____

Site Location: _____

Scope of Work: _____

Site Safety Officer: _____ Construction Manager: _____

Safety Topics Presented

Protective Clothing/Equipment: _____

Chemical Hazards: _____

Physical Hazards: _____

Special Equipment: _____

Emergency Procedures/Designated Gathering Location: _____

Hospital: _____ Phone: _____ Ambulance Phone: _____

Hospital Address: _____ Hospital Route: _____

Attendees

Name Printed:	Signature:

Meeting Conducted By: _____ Signed By: _____

AIR MONITORING DATA SHEET

DATE	TIME	LOCATION	INSTRUMENT READING	COMMENTS

Site Safety Officer:_____ Date:_____

Accident/Incident Analysis

AIA Report **Case Number**

Employee's Name:	Payroll Number:	Division: Location Name:	Dept or Org. No.
Job Assignment at time of Accident/Incident::			
Time in Job Assignment ☐ 0-14 days. ☐ 15-90 days. ☐ 3 months to 1 year. ☐ 1-3 years. ☐ 4-10 years. ☐ more than 10 years			Job Assigned was a Routine Part of Job ☐ Yes ☐ No
Date of Accident/incident (mm/dd/yyyy)	Time: ☐ AM ☐ PM	Date Reported to You – Please Specify if Other: ☐ Same as Accident/Incident ☐ Other	
Injury Treated by at Time of Accident/Incident ☐ First Aid ☐ EMT ☐ Health Services ☐ No Treatment	**Name(s) of Witness(es)**		
Injury Type (cut, bruise, strain, etc.)	**Injury Location** (hand, foot, lower back, etc.)	**Extent of Injury** (minor, severe, length of cut, etc.)	
Describe What Happened (Detail **what** the employee was doing – **where** the accident/incident occurred – **what** tools, equipment, or people were involved.) Remember facts are important; fault finding is not. Text box will expand			
OSHA Recordable Incident ☐ Yes ☐ No	Last Day Worked (If time lost.)	Date ☐ Returned or ☐ Expected Date	
Describe Property Damage (if any) Text box will expand	Approximate Costs Associated with Property Damage		

Root Cause and Contributory Causes		**Corrective Actions Taken by You or Others**	
1		**1**	
2		**2**	
3		**3**	
4		**4**	
5		**5**	

Reference Documents			
Manager's Comments/Actions (if any)			
Safety and Health Representative's Comments/Actions			
Employee's Name and Date	**Supervisor's Name and Date**	**Manager's Name and Date**	**SH/ER Representative's Name and Date**

Revision Number	**Effective Date**	**Description of Changes**
0	08/12/05	Initial release

ATTACHMENT 2

MATERIAL SAFETY DATA SHEETS

World Headquarters
Hach Company
P.O.Box 389
Loveland, CO USA 80539
(970) 669-3050

Date Printed 12/13/04
MSDS No: M00046

MATERIAL SAFETY DATA SHEET

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Name: SulfaVer ® 4 Sulfate Reagent
Catalog Number: 1206599

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P.O.Box 389
Loveland, CO USA 80539
(970) 669-3050

Emergency Telephone Numbers:
(Medical and Transportation)
(303) 623-5716 24 Hour Service
(515)232-2533 8am - 4pm CST

MSDS Number: M00046
Chemical Name: Not applicable
CAS No.: Not applicable
Chemical Formula: Not applicable
Chemical Family: Not applicable
Hazard: Causes severe eye irritation.
Date of MSDS Preparation:
Day: 13
Month: 12
Year: 2004

2. COMPOSITION / INFORMATION ON INGREDIENTS

Barium Chloride
CAS No.: 10326-27-9
TSCA CAS Number: 10361-37-2
Percent Range: 40.0 - 50.0
Percent Range Units: weight / weight
LD50: Oral rat LD50 = 118 mg/kg Oral Human LDLo = 11400 µg/kg
LC50: None reported
TLV: 0.5 mg/m^3 as Ba
PEL: 0.5 mg/m^3 as Ba
Hazard: May cause irritation. Toxic.

Citric Acid
CAS No.: 77-92-9
TSCA CAS Number: 77-92-9
Percent Range: 55.0 - 65.0
Percent Range Units: weight / weight
LD50: Oral rat LD50 = 6730 mg/Kg
LC50: None reported
TLV: Not established
PEL: Not established
Hazard: Causes severe eye irritation.

3. HAZARDS IDENTIFICATION

Emergency Overview:
Appearance: White powder
Odor: None
CAUSES EYE IRRITATION MAY CAUSE SKIN AND RESPIRATORY TRACT IRRITATION

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HMIS:
Health: 2
Flammability: 0
Reactivity: 0
Protective Equipment: X - See protective equipment, Section 8.
NFPA:
Health: 2
Flammability: 1
Reactivity: 0
Symbol: Not applicable
Potential Health Effects:
Eye Contact: Causes severe irritation
Skin Contact: Causes moderate irritation
Skin Absorption: None reported
Target Organs: None reported
Ingestion: Barium compounds cause central nervous system stimulation followed by central nervous system depression. Barium compounds cause stimulation of the muscles which may result in muscle twitching, cramps and weakness; blood pressure effects; disturbance of the heart's action and respiratory paralysis. Causes: abdominal pain dizziness Can cause: paralysis of tongue limb immobility death kidney damage
Target Organs: Cardiovascular system Central nervous system Muscles Kidneys
Inhalation: Barium compounds cause central nervous system stimulation followed by central nervous system depression. Barium compounds cause stimulation of the muscles which may result in muscle twitching, cramps and weakness; blood pressure effects; disturbance in the heart's action and respiratory paralysis. Causes: abdominal pain dizziness Can cause: paralysis of tongue limb immobility death kidney damage
Target Organs: Cardiovascular system Central nervous system Muscles Kidneys
Medical Conditions Aggravated: None reported
Chronic Effects: Citric acid chronic overexposure may cause effects due to the ability of citric acid to chelate metals, which could impair the body's ability to absorb calcium and iron. Chronic overexposure may cause kidney damage
Cancer / Reproductive Toxicity Information:
This product does NOT contain any OSHA listed carcinogens.

This product does NOT contain any IARC listed chemicals.

This product does NOT contain any NTP listed chemicals.

Additional Cancer / Reproductive Toxicity Information: None reported
Toxicologically Synergistic Products: None reported

4. FIRST AID

Eye Contact: Immediately flush eyes with water for 15 minutes. Call physician.
Skin Contact (First Aid): Wash skin with plenty of water. Call physician if irritation develops.
Ingestion (First Aid): Induce vomiting using syrup of ipecac or by sticking finger down throat. Give 1 tablespoon of epsom salt in a glass of water. Call physician immediately. Never give anything by mouth to an unconscious person.
Inhalation: Remove to fresh air. Give artificial respiration if necessary. Call physician.

5. FIRE FIGHTING MEASURES

Flammable Properties: Can burn in fire, releasing toxic vapors. During a fire, irritating and highly toxic gases may be generated by thermal decomposition.
Flash Point: Not applicable
Method: Not applicable
Flammability Limits:
Lower Explosion Limits: Not applicable
Upper Explosion Limits: Not applicable
Autoignition Temperature: Not determined
Hazardous Combustion Products: Toxic fumes of: carbon monoxide, carbon dioxide, chlorides
Fire / Explosion Hazards: May react violently with: strong oxidizers
Static Discharge: None reported.

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Mechanical Impact: None reported
Extinguishing Media: Use media appropriate to surrounding fire conditions
Fire Fighting Instruction: As in any fire, wear self-contained breathing apparatus pressure-demand and full protective gear.

6. ACCIDENTAL RELEASE MEASURES

Spill Response Notice:
Only persons properly qualified to respond to an emergency involving hazardous substances may respond to a spill according to federal regulations (OSHA 29 CFR 1910.120(a)(v)) and per your company's emergency response plan and guidelines/procedures. See Section 13, Special Instructions for disposal assistance.
Containment Technique: Releases of this material may contaminate the environment. Stop spilled material from being released to the environment.
Clean-up Technique: Avoid contact with spilled material. Sweep up material. Dispose of material in an E.P.A. approved hazardous waste facility. Decontaminate the area of the spill with a soap solution.
Evacuation Procedure: Evacuate local area (15 foot radius or as directed by your facility's emergency response plan) when: any quantity is spilled. If conditions warrant, increase the size of the evacuation.
Special Instructions (for accidental release): Mixture contains a component which is regulated as hazardous waste.
304 EHS RQ (40 CFR 355): Not applicable
D.O.T. Emergency Response Guide Number: None

7. HANDLING / STORAGE

Handling: Avoid contact with: eyes skin clothing Do not breathe: dust. Wash thoroughly after handling. Maintain general industrial hygiene practices when using this product.
Storage: Store away from: oxidizers Protect from: moisture
Flammability Class: Not applicable

8. EXPOSURE CONTROLS / PROTECTIVE EQUIPMENT

Engineering Controls: Have an eyewash station nearby. Use a fume hood to avoid exposure to dust, mist or vapor. Maintain general industrial hygiene practices when using this product.
Personal Protective Equipment:
Eye Protection: safety glasses with top and side shields
Skin Protection: disposable latex gloves lab coat
Inhalation Protection: adequate ventilation
Precautionary Measures: Avoid contact with: eyes skin clothing Do not breathe: dust Wash thoroughly after handling. Protect from: moisture Keep away from: oxidizers
TLV: Not established
PEL: Not established

9. PHYSICAL / CHEMICAL PROPERTIES

Appearance: White powder
Physical State: Solid
Molecular Weight: Not applicable
Odor: None
pH: of a 5% solution ~ 2.0
Vapor Pressure: Not applicable
Vapor Density (air = 1): Not applicable
Boiling Point: Not applicable
Melting Point: ~ 124 °C (255 °F)
Specific Gravity (water = 1): ~2
Evaporation Rate (water = 1): Not applicable
Volatile Organic Compounds Content: Not applicable
Partition Coefficient (n-octanol / water): Not applicable
Solubility:
Water: Soluble

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Acid: Not determined
Other: Not determined
Metal Corrosivity:
Steel: Not applicable
Aluminum: Not applicable

10. STABILITY / REACTIVITY

Chemical Stability: Stable when stored under proper conditions.
Conditions to Avoid: Excess moisture Extreme temperatures
Reactivity / Incompatibility: Incompatible with: oxidizers bromine trifluoride 2-furan percarboxylic acid metal nitrates metal nitrites
Hazardous Decomposition: Heating to decomposition releases toxic and/or corrosive fumes of: carbon dioxide carbon monoxide chlorides
Hazardous Polymerization: Will not occur.

11. TOXICOLOGICAL INFORMATION

Product Toxicological Data:
LD50: Oral rat LD50 = 680 mg/kg
LC50: None reported
Dermal Toxicity Data: None reported
Skin and Eye Irritation Data: Citric Acid: Standard Draize Test Skin rabbit 500 mg/24 hour = MODERATE. Citric Acid: Standard Draize Test Eye rabbit 750 µg/24 hour = SEVERE.
Mutation Data: None reported
Reproductive Effects Data: None reported
Ingredient Toxicological Data: Barium Chloride Oral rat LD50 = 118 mg/kg; Citric Acid Oral rat LD50 = 6730 mg/kg

12. ECOLOGICAL INFORMATION

Product Ecological Information: –
No ecological data available for this product.
Ingredient Ecological Information: –
No ecological data available for the ingredients of this product.

13. DISPOSAL CONSIDERATIONS

EPA Waste ID Number: D005
Special Instructions (Disposal): Dispose of material in an E.P.A. approved hazardous waste facility.
Empty Containers: Rinse three times with an appropriate solvent. Dispose of empty container as normal trash.
NOTICE (Disposal): These disposal guidelines are based on federal regulations and may be superseded by more stringent state or local requirements. Please consult your local environmental regulators for more information.

14. TRANSPORT INFORMATION

D.O.T.:
D.O.T. Proper Shipping Name: Not Currently Regulated
–
DOT Hazard Class: NA
DOT Subsidiary Risk: NA
DOT ID Number: NA
DOT Packing Group: NA
I.C.A.O.:
I.C.A.O. Proper Shipping Name: Not Currently Regulated
–
ICAO Hazard Class: NA

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ICAO Subsidiary Risk: NA
ICAO ID Number: NA
ICAO Packing Group: NA
I.M.O.:
I.M.O. Proper Shipping Name: Not Currently Regulated
I.M.O. Hazard Class: NA
I.M.O. Subsidiary Risk: NA
I.M.O. ID Number: NA
I.M.O. Packing Group: NA
Additional Information: This product may be shipped as part of a chemical kit composed of various compatible dangerous goods for analytical or testing purposes. This kit would have the following classification: Proper Shipping Name: Chemical Kit Hazard Class: 9 UN Number 3316

15. REGULATORY INFORMATION

U.S. Federal Regulations:
O.S.H.A.: This product meets the criteria for a hazardous substance as defined in the Hazard Communication Standard. (29 CFR 1910.1200)
E.P.A.:
S.A.R.A. Title III Section 311/312 Categorization (40 CFR 370): Immediate (Acute) Health Hazard Delayed (Chronic) Health Hazard
S.A.R.A. Title III Section 313 (40 CFR 372): This product contains a chemical(s) subject to the reporting requirements of Section 313 of Title III of SARA.
Barium Chloride
302 (EHS) TPQ (40 CFR 355): Not applicable
304 CERCLA RQ (40 CFR 302.4): Not applicable
304 EHS RQ (40 CFR 355): Not applicable
Clean Water Act (40 CFR 116.4): Not applicable
RCRA: Contains RCRA regulated substances. See Section 13, EPA Waste ID Number.
C.P.S.C.: Not applicable
State Regulations:
California Prop. 65: No Prop. 65 listed chemicals are present in this product.
Identification of Prop. 65 Ingredient(s): Not applicable
Trade Secret Registry: Not applicable
National Inventories:
U.S. Inventory Status: All ingredients in this product are listed on the TSCA 8(b) Inventory (40 CFR 710).
TSCA CAS Number: Not applicable

16. OTHER INFORMATION

Intended Use: Sulfate determination
References: TLV's Threshold Limit Values and Biological Exposure Indices for 1992-1993. American Conference of Governmental Industrial Hygienists, 1992. Air Contaminants, Federal Register, Vol. 54, No. 12. Thursday, January 19, 1989. pp. 2332-2983. In-house information. Technical Judgment. Outside Testing. Vendor Information. Gosselin, R. E. et al. Clinical Toxicology of Commercial Products, 5th Ed. Baltimore: The Williams and Wilkins Co., 1984. Sax, N. Irving. Dangerous Properties of Industrial Materials, 7th Ed. New York: Van Nostrand Reinhold Co., 1989. Patty, Frank A. Industrial Hygiene and Toxicology, 3rd Revised Edition. Volume 2. New York: A Wiley-Interscience Publication, 1981. NIOSH Registry of Toxic Effects of Chemical Substances, 1985-86. Cincinnati: U.S. Department of Health and Human Services, April, 1987.
Revision Summary: Updates in Section(s) 14,

Legend:

NA - Not Applicable	w/w - weight/weight
ND - Not Determined	w/v - weight/volume
NV - Not Available	v/v - volume/volume

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USER RESPONSIBILITY: Each user should read and understand this information and incorporate it in individual site safety programs in accordance with applicable hazard communication standards and regulations.

THE INFORMATION CONTAINED HEREIN IS BASED ON DATA CONSIDERED TO BE ACCURATE. HOWEVER, NO WARRANTY IS EXPRESSED OR IMPLIED REGARDING THE ACCURACY OF THESE DATA OR THE RESULTS TO BE OBTAINED FROM THE USE THEREOF.

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MATERIAL SAFETY DATA SHEET

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Name: PhosVer ® 3 Phosphate Reagent
Catalog Number: 2106069

Hach Company
P.O.Box 389
Loveland, CO USA 80539
(970) 669-3050

Emergency Telephone Numbers:
(Medical and Transportation)
(303) 623-5716 24 Hour Service
(515)232-2533 8am - 4pm CST

MSDS Number: M00035
Chemical Name: Not applicable
CAS No.: Not applicable
Chemical Formula: Not applicable
Chemical Family: Not applicable
Hazard: Causes eye burns.
Date of MSDS Preparation:
Day: 23
Month: 09
Year: 2004

2. COMPOSITION / INFORMATION ON INGREDIENTS

Potassium Pyrosulfate
CAS No.: 7790-62-7
TSCA CAS Number: 7790-62-7
Percent Range: 75.0 - 85.0
Percent Range Units: weight / weight
LD50: Oral rat LD50 = 2340 mg/kg
LC50: None reported
TLV: Not established
PEL: Not established
Hazard: Causes eye burns.

Ascorbic Acid
CAS No.: 50-81-7
TSCA CAS Number: 50-81-7
Percent Range: 15.0 - 25.0
Percent Range Units: weight / weight
LD50: Oral rat LD50 = 11900 mg/kg
LC50: None reported
TLV: Not established
PEL: Not established
Hazard: Practically non-toxic.

Sodium Molybdate
CAS No.: 10102-40-6
TSCA CAS Number: 7631-95-0
Percent Range: 1.0 - 10.0
Percent Range Units: weight / weight
LD50: Oral rat LD_{50} = 4000 mg/kg.
LC50: Inhalation rat LC50 - > 2080 mg/m³/4 hrs
TLV: 5 mg/m³ (as Mo)
PEL: 5 mg/m³ (as Mo)
Hazard: May cause irritation.

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Other components, each

CAS No.: Not applicable
TSCA CAS Number: Not applicable
Percent Range: 0.1 - 1.0
Percent Range Units: weight / weight
LD50: Not applicable
LC50: Not applicable
TLV: Not established
PEL: Not established
Hazard: Any ingredient(s) of this product listed as "Other component(s)" is not considered a health hazard to the user of this product.

3. HAZARDS IDENTIFICATION

Emergency Overview:
Appearance: White to off-white powder
Odor: None
CAUSES EYE BURNS MAY CAUSE RESPIRATORY TRACT IRRITATION.

HMIS:
Health: 3
Flammability: 1
Reactivity: 0
Protective Equipment: X - See protective equipment, Section 8.
NFPA:
Health: 3
Flammability: 1
Reactivity: 0
Symbol: Not applicable
Potential Health Effects:
Eye Contact: Causes eye burns.
Skin Contact: No effects are anticipated
Skin Absorption: None reported
Target Organs: None reported
Ingestion: May cause: copper deficiency anemia gout loss of appetite loss of coordination listlessness diarrhea liver damage May effect enzyme activity.
Target Organs: Blood Liver
Inhalation: May cause: respiratory tract irritation Effects similar to those of ingestion.
Target Organs: Blood Liver
Medical Conditions Aggravated: Pre-existing: Eye conditions Respiratory conditions Gout
Chronic Effects: Chronic overexposure may cause copper deficiency enzyme activity effects liver damage Molybdenum poisoning signs include loss of appetite, listlessness and reduced growth rate. Excessive exposure to molybdenum compounds may cause gout and anemia.
Cancer / Reproductive Toxicity Information:
This product does NOT contain any OSHA listed carcinogens.

This product does NOT contain any IARC listed chemicals.

This product does NOT contain any NTP listed chemicals.

Additional Cancer / Reproductive Toxicity Information: Contains: an experimental mutagen.
Toxicologically Synergistic Products: None reported

4. FIRST AID

Eye Contact: Immediately flush eyes with water for 15 minutes. Call physician.

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Skin Contact (First Aid): Wash skin with plenty of water.
Ingestion (First Aid): Do not induce vomiting. Give 1-2 glasses of water. Call physician immediately. Never give anything by mouth to an unconscious person.
Inhalation: Remove to fresh air. Give artificial respiration if necessary. Call physician.

5. FIRE FIGHTING MEASURES

Flammable Properties: Can burn in fire, releasing toxic vapors.
Flash Point: Not applicable
Method: Not applicable
Flammability Limits:
Lower Explosion Limits: Not applicable
Upper Explosion Limits: Not applicable
Autoignition Temperature: Not determined
Hazardous Combustion Products: Toxic fumes of: sulfur oxides. carbon monoxide, carbon dioxide. sodium monoxide
Fire / Explosion Hazards: None reported
Static Discharge: None reported.
Mechanical Impact: None reported
Extinguishing Media: Use media appropriate to surrounding fire conditions
Fire Fighting Instruction: As in any fire, wear self-contained breathing apparatus pressure-demand and full protective gear.

6. ACCIDENTAL RELEASE MEASURES

Spill Response Notice:
Only persons properly qualified to respond to an emergency involving hazardous substances may respond to a spill according to federal regulations (OSHA 29 CFR 1910.120(a)(v)) and per your company's emergency response plan and guidelines/procedures. See Section 13, Special Instructions for disposal assistance.
Containment Technique: Stop spilled material from being released to the environment.
Clean-up Technique: Scoop up spilled material into a large beaker and dissolve with water. Adjust to a pH between 6 and 9 with an alkali, such as soda ash or sodium bicarbonate. Flush reacted material to the drain with a large excess of water. Decontaminate the area of the spill with a soap solution.
Evacuation Procedure: Evacuate local area (15 foot radius or as directed by your facility's emergency response plan) when: any quantity is spilled.
Special Instructions (for accidental release): Not applicable
304 EHS RQ (40 CFR 355): Not applicable
D.O.T. Emergency Response Guide Number: None

7. HANDLING / STORAGE

Handling: Avoid contact with eyes Do not breathe dust. Wash thoroughly after handling. Maintain general industrial hygiene practices when using this product.
Storage: Store between 10° and 25°C.
Flammability Class: Not applicable

8. EXPOSURE CONTROLS / PROTECTIVE EQUIPMENT

Engineering Controls: Have an eyewash station nearby. Maintain general industrial hygiene practices when using this product.
Personal Protective Equipment:
Eye Protection: safety glasses with top and side shields
Skin Protection: disposable latex gloves lab coat
Inhalation Protection: adequate ventilation
Precautionary Measures: Avoid contact with: eyes Do not breathe: dust Wash thoroughly after handling.
TLV: Not established
PEL: Not established

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9. PHYSICAL / CHEMICAL PROPERTIES

Appearance: White to off-white powder
Physical State: Solid
Molecular Weight: Not applicable
Odor: None
pH: of a 5% solution = 1.5
Vapor Pressure: Not applicable
Vapor Density (air = 1): Not applicable
Boiling Point: Not applicable
Melting Point: 105 °C (221 °F)
Specific Gravity (water = 1): 2.22
Evaporation Rate (water = 1): Not applicable
Volatile Organic Compounds Content: Not applicable
Partition Coefficient (n-octanol / water): Not applicable
Solubility:
- ***Water:*** Soluble
- ***Acid:*** Soluble
- ***Other:*** Not determined

Metal Corrosivity:
- ***Steel:*** Not applicable
- ***Aluminum:*** Not applicable

10. STABILITY / REACTIVITY

Chemical Stability: Stable when stored under proper conditions.
Conditions to Avoid: Extreme temperatures
Reactivity / Incompatibility: Incompatible with: oxidizers dyes alkalies iron copper
Hazardous Decomposition: Heating to decomposition releases: carbon dioxide carbon monoxide sulfur oxides
Hazardous Polymerization: Will not occur.

11. TOXICOLOGICAL INFORMATION

Product Toxicological Data:
- ***LD50:*** None reported
- ***LC50:*** None reported
- ***Dermal Toxicity Data:*** None reported
- ***Skin and Eye Irritation Data:*** None reported
- ***Mutation Data:*** None reported
- ***Reproductive Effects Data:*** None reported

Ingredient Toxicological Data: Potassium Pyrosulfate Oral rat LD50 = 2340 mg/kg; Sodium Molybdate Oral rat LD50 = 4000 mg/kg, Inhalation rat LC50 > 2080mg/m^3/4 hr; Ascorbic Acid Oral rat LD50 = 11.9 g/kg

12. ECOLOGICAL INFORMATION

Product Ecological Information: --
No ecological data available for this product.
Ingredient Ecological Information: --
No ecological data available for the ingredients of this product.

13. DISPOSAL CONSIDERATIONS

EPA Waste ID Number: None
Special Instructions (Disposal): Work in an approved fume hood. Dilute material with excess water making a weaker than 5% solution. Adjust to a pH between 6 and 9 with an alkali, such as soda ash or sodium bicarbonate. Open cold water tap completely, slowly pour the reacted material to the drain. Allow cold water to run for 5 minutes to completely flush the system.

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Empty Containers: Rinse three times with an appropriate solvent. Dispose of empty container as normal trash.
NOTICE (Disposal): These disposal guidelines are based on federal regulations and may be superseded by more stringent state or local requirements. Please consult your local environmental regulators for more information.

14. TRANSPORT INFORMATION

D.O.T.:
D.O.T. Proper Shipping Name: Not Currently Regulated
--
DOT Hazard Class: NA
DOT Subsidiary Risk: NA
DOT ID Number: NA
DOT Packing Group: NA
I.C.A.O.:
I.C.A.O. Proper Shipping Name: Not Currently Regulated
--
ICAO Hazard Class: NA
ICAO Subsidiary Risk: NA
ICAO ID Number: NA
ICAO Packing Group: NA
I.M.O.:
I.M.O. Proper Shipping Name: Not Currently Regulated
--
I.M.O. Hazard Class: NA
I.M.O. Subsidiary Risk: NA
I.M.O. ID Number: NA
I.M.O. Packing Group: NA
Additional Information: This product may be shipped as part of a chemical kit composed of various compatible dangerous goods for analytical or testing purposes. This kit would have the following classification: Proper Shipping Name: Chemical Kit Hazard Class: 9 UN Number 3316

15. REGULATORY INFORMATION

U.S. Federal Regulations:
O.S.H.A.: This product meets the criteria for a hazardous substance as defined in the Hazard Communication Standard (29 CFR 1910.1200)
E.P.A.:
S.A.R.A. Title III Section 311/312 Categorization (40 CFR 370): Immediate (Acute) Health Hazard Delayed (Chronic) Health Hazard
S.A.R.A. Title III Section 313 (40 CFR 372): This product does NOT contain any chemical subject to the reporting requirements of Section 313 of Title III of SARA
--
302 (EHS) TPQ (40 CFR 355): Not applicable
304 CERCLA RQ (40 CFR 302.4): Not applicable
304 EHS RQ (40 CFR 355): Not applicable
Clean Water Act (40 CFR 116.4): Not applicable
RCRA: Contains no RCRA regulated substances.
C.P.S.C.: Not applicable
State Regulations:
California Prop. 65: No Prop. 65 listed chemicals are present in this product.
Identification of Prop. 65 Ingredient(s): Not applicable
Trade Secret Registry: Not applicable
National Inventories:
U.S. Inventory Status: All ingredients in this product are listed on the TSCA 8(b) Inventory (40 CFR 710).
TSCA CAS Number: Not applicable

16. OTHER INFORMATION

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Intended Use: Phosphate determination

References: TLV's Threshold Limit Values and Biological Exposure Indices for 1992-1993. American Conference of Governmental Industrial Hygienists, 1992. Air Contaminants, Federal Register, Vol. 54, No. 12. Thursday, January 19, 1989. pp. 2332-2983. In-house information. Technical Judgment. Outside Testing. NIOSH/OSHA Occupational Health Guidelines for Chemical Hazards. Cincinnati: Department of Health and Human Services, 1981. Sax, N. Irving. Dangerous Properties of Industrial Materials, 7th Ed. New York: Van Nostrand Reinhold Co., 1989. Gosselin, R. E. et al. Clinical Toxicology of Commercial Products, 5th Ed. Baltimore: The Williams and Wilkins Co., 1984. Vendor Information. Patty, Frank A. Industrial Hygiene and Toxicology, 3rd Revised Edition. Volume 2. New York: A Wiley-Interscience Publication, 1981.

Revision Summary: Updates in Section(s) 14,

Legend:

NA - Not Applicable	w/w - weight/weight
ND - Not Determined	w/v - weight/volume
NV - Not Available	v/v - volume/volume

USER RESPONSIBILITY: Each user should read and understand this information and incorporate it in individual site safety programs in accordance with applicable hazard communication standards and regulations.

THE INFORMATION CONTAINED HEREIN IS BASED ON DATA CONSIDERED TO BE ACCURATE. HOWEVER, NO WARRANTY IS EXPRESSED OR IMPLIED REGARDING THE ACCURACY OF THESE DATA OR THE RESULTS TO BE OBTAINED FROM THE USE THEREOF.

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MATERIAL SAFETY DATA SHEET

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Name: NitraVer ® 5 Nitrate Reagent
Catalog Number: 2106169

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(970) 669-3050

Emergency Telephone Numbers:
(Medical and Transportation)
(303) 623-5716 24 Hour Service
(515)232-2533 8am - 4pm CST

MSDS Number: M00049
Chemical Name: Not applicable
CAS No.: Not applicable
Chemical Formula: Not applicable
Chemical Family: Not applicable
Hazard: Toxic. Cumulative poison. Recognized carcinogen. Experimental teratogen. May cause irritation.
Date of MSDS Preparation:
Day: 23
Month: 03
Year: 2005

2. COMPOSITION / INFORMATION ON INGREDIENTS

Potassium Phosphate, Monobasic
CAS No.: 7778-77-0
TSCA CAS Number: 7778-77-0
Percent Range: 30.0 - 40.0
Percent Range Units: weight / weight
LD50: Oral rat LD50 = 7100 mg/kg
LC50: None reported
TLV: Not established
PEL: Not established
Hazard: May cause irritation.

Other components, each
CAS No.: Not applicable
TSCA CAS Number: Not applicable
Percent Range: < 1.0
Percent Range Units: weight / weight
LD50: Not applicable
LC50: Not applicable
TLV: Not established
PEL: Not established
Hazard: Any ingredient(s) of this product listed as "Other component(s)" is not considered a health hazard to the user of this product.

Magnesium Sulfate
CAS No.: 10034-99-8
TSCA CAS Number: 7487-88-9
Percent Range: 5.0 - 15.0
Percent Range Units: weight / weight
LD50: Oral mouse LDLo = 5000 mg/kg
LC50: None reported
TLV: Not established
PEL: Not established
Hazard: May cause irritation.

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Cadmium
CAS No.: 7440-43-9
TSCA CAS Number: 7440-43-9
Percent Range: 5.0 - 10.0
Percent Range Units: weight / weight
LD50: Oral rat LD50 = 225 mg/kg
LC50: Inhalation rat LC50 = 25 mg/m^3/30min
TLV: 0.01 mg/m^3
PEL: 0.005 mg/m^3
Hazard: Toxic. Recognized carcinogen. Cumulative poison. May cause irritation. Experimental teratogen.

Gentisic Acid
CAS No.: 490-79-9
TSCA CAS Number: 490-79-9
Percent Range: 15.0 - 25.0
Percent Range Units: weight / weight
LD50: Oral rat LD50 = 800 mg/kg, Oral mouse LD50 = 4500 mg/kg
LC50: None reported
TLV: Not established
PEL: Not established
Hazard: May cause irritation.

Sulfanilic Acid
CAS No.: 121-57-3
TSCA CAS Number: 121-57-3
Percent Range: 25.0 - 35.0
Percent Range Units: weight / weight
LD50: Oral rat LD50 = 12300 mg/kg
LC50: None reported
TLV: Not established
PEL: Not established
Hazard: May cause irritation.

3. HAZARDS IDENTIFICATION

Emergency Overview:
Appearance: Gray powder
Odor: None
HARMFUL IF INHALED MAY CAUSE EYE, SKIN AND RESPIRATORY TRACT IRRITATION
CONTAINS CADMIUM: CANCER HAZARD CAN CAUSE LUNG AND KIDNEY DISEASE

HMIS:
Health: 4*
Flammability: 1
Reactivity: 0
Protective Equipment: X - See protective equipment, Section 8.
NFPA:
Health: 3
Flammability: 1
Reactivity: 0
Symbol: Not applicable
Potential Health Effects:
Eye Contact: May cause irritation
Skin Contact: May cause irritation
Skin Absorption: None reported
Target Organs: None reported

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Ingestion: May cause: salivation vomiting abdominal pain anemia diarrhea kidney failure central nervous system effects cardiac depression
Target Organs: Kidneys Reproductive system Central nervous system
Inhalation: May cause: coughing headache nausea, vomiting chest pain pneumonitis respiratory tract irritation lung damage kidney damage
Target Organs: Kidneys Reproductive system Lungs
Medical Conditions Aggravated: Pre-existing: Respiratory conditions Kidney conditions Liver conditions
Chronic Effects: Chronic overexposure may cause cancer liver damage kidney damage bone damage (osteosclerosis)
Cancer / Reproductive Toxicity Information:
An ingredient of this product is an OSHA listed carcinogen.
Cadmium
An ingredient of this mixture is: IARC Group 1: Recognized Carcinogen
Cadmium
An ingredient of this mixture is: NTP Listed Group 1: Recognized Carcinogen
Cadmium
Additional Cancer / Reproductive Toxicity Information: Contains: an ACGIH A2 suspected human carcinogen.
Toxicologically Synergistic Products: None reported

4. FIRST AID

Eye Contact: Immediately flush eyes with water for 15 minutes. Call physician.
Skin Contact (First Aid): Wash skin with soap and plenty of water. Call physician if irritation develops.
Ingestion (First Aid): Administer milk or beaten egg whites at frequent intervals. Induce vomiting using syrup of ipecac or by sticking finger down throat. Never give anything by mouth to an unconscious person. Call physician immediately.
Inhalation: Remove to fresh air. Give artificial respiration if necessary. Call physician.

5. FIRE FIGHTING MEASURES

Flammable Properties: Can burn in fire, releasing toxic vapors.
Flash Point: Not applicable
Method: Not applicable
Flammability Limits:
Lower Explosion Limits: Not applicable
Upper Explosion Limits: Not applicable
Autoignition Temperature: Not available
Hazardous Combustion Products: Toxic fumes of: cadmium oxide nitrogen oxides. sulfur oxides. phosphorus oxides
Fire / Explosion Hazards: May react violently with: strong oxidizers hydrazoic acid ammonium nitrate
Static Discharge: None reported.
Mechanical Impact: None reported
Extinguishing Media: Water. Carbon dioxide Dry chemical.
Fire Fighting Instruction: As in any fire, wear self-contained breathing apparatus pressure-demand and full protective gear.

6. ACCIDENTAL RELEASE MEASURES

Spill Response Notice:
Only persons properly qualified to respond to an emergency involving hazardous substances may respond to a spill according to federal regulations (OSHA 29 CFR 1910.120(a)(v)) and per your company's emergency response plan and guidelines/procedures. See Section 13, Special Instructions for disposal assistance.
Containment Technique: Releases of this material may contaminate the environment. Stop spilled material from being released to the environment.
Clean-up Technique: Avoid breathing spilled material. Avoid contact with spilled material. Sweep up material. Dispose of material in an E.P.A. approved hazardous waste facility. Decontaminate the area of the spill with a soap solution.
Evacuation Procedure: Evacuate general area (50 foot radius or as directed by your facility's emergency response plan) when: any quantity is spilled. If conditions warrant, increase the size of the evacuation.
Special Instructions (for accidental release): Product is regulated as RCRA hazardous waste.
304 EHS RQ (40 CFR 355): Not applicable
D.O.T. Emergency Response Guide Number: None

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7. HANDLING / STORAGE

Handling: Avoid contact with eyes skin clothing Do not breathe dust. Wash thoroughly after handling. Maintain general industrial hygiene practices when using this product. Use with adequate ventilation.
Storage: Store between 10° and 25°C. Keep away from: oxidizers hydrazoic acid ammonium nitrate
Flammability Class: Not applicable

8. EXPOSURE CONTROLS / PROTECTIVE EQUIPMENT

Engineering Controls: Have an eyewash station nearby. Maintain adequate ventilation to keep vapor level below TWA for chemicals in this product. Use a fume hood to avoid exposure to dust, mist or vapor.
Personal Protective Equipment:
Eye Protection: safety glasses with top and side shields
Skin Protection: disposable latex gloves lab coat
Inhalation Protection: laboratory fume hood and / or half-face respirator with HEPA filter
Precautionary Measures: Avoid contact with: eyes skin clothing Do not breathe: dust Wash thoroughly after handling. Keep away from: oxidizers
TLV: Not established
PEL: Not established

9. PHYSICAL / CHEMICAL PROPERTIES

Appearance: Gray powder
Physical State: Solid
Molecular Weight: Not applicable
Odor: None
pH: 5% solution = 2.8
Vapor Pressure: Not applicable
Vapor Density (air = 1): Not applicable
Boiling Point: Not applicable
Melting Point: 180°C; 356°F
Specific Gravity (water = 1): 2.0
Evaporation Rate (water = 1): Not applicable
Volatile Organic Compounds Content: Not applicable
Partition Coefficient (n-octanol / water): Not applicable
Solubility:
Water: Soluble
Acid: Soluble
Other: Not determined
Metal Corrosivity:
Steel: 0.081 in/yr
Aluminum: 0.000 in/yr

10. STABILITY / REACTIVITY

Chemical Stability: Stable when stored under proper conditions.
Conditions to Avoid: Heat
Reactivity / Incompatibility: Incompatible with: oxidizers hydrazoic acid ammonium nitrate sulfur
Hazardous Decomposition: Heating to decomposition releases toxic and/or corrosive fumes of: phosphorus oxides sulfur oxides carbon dioxide carbon monoxide nitrogen oxides
Hazardous Polymerization: Will not occur.

11. TOXICOLOGICAL INFORMATION

Product Toxicological Data:
LD50: Oral rat LD50 1500 mg/kg

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LC50: None reported
Dermal Toxicity Data: None reported
Skin and Eye Irritation Data: Sulfanilic acid: Skin rabbit 500 mg/24H - Standard Draize - MILD; Eye rabbit 100 mg/24H - Standard Draize - MODERATE
Mutation Data: Cadmium - Cytogenetic analysis - hamster ovary 1 µmol/l
Reproductive Effects Data: Cadmium: Oral male rat TDLo = 155 mg/kg - 13 weeks pre-mating - effects on newborn growth and behavior; Oral female rat TDLo = 23 mg/kg - 1-22 days after conception - blood and lymphatic system abnormalities
Ingredient Toxicological Data: Cadmium: Oral rat LD50 = 225 mg/kg, Inhalation rat LC50 = 25 mg/m^3/30 min; Gentisic acid Oral rat LD50 = 800 mg/kg; Sulfanilic acid Oral rat LD50 = 12.3 g/kg; KH_2PO_4 Oral rat LD50 = 7100 mg/kg

12. ECOLOGICAL INFORMATION

Product Ecological Information: --
No ecological data available for this product.
Ingredient Ecological Information: --
No ecological data available for the ingredients of this product.

13. DISPOSAL CONSIDERATIONS

EPA Waste ID Number: D006
Special Instructions (Disposal): Dispose of material in an E.P.A. approved hazardous waste facility.
Empty Containers: Rinse three times with an appropriate solvent. Rinsate from empty containers may contain sufficient product to require disposal as hazardous waste. Dispose of empty container as normal trash.
NOTICE (Disposal): These disposal guidelines are based on federal regulations and may be superseded by more stringent state or local requirements. Please consult your local environmental regulators for more information.

14. TRANSPORT INFORMATION

D.O.T.:
D.O.T. Proper Shipping Name: Not Currently Regulated
--
DOT Hazard Class: NA
DOT Subsidiary Risk: NA
DOT ID Number: NA
DOT Packing Group: NA
I.C.A.O.:
I.C.A.O. Proper Shipping Name: Not Currently Regulated
--
ICAO Hazard Class: NA
ICAO Subsidiary Risk: NA
ICAO ID Number: NA
ICAO Packing Group: NA
I.M.O.:
I.M.O. Proper Shipping Name: Not Currently Regulated
--
I.M.O. Hazard Class: NA
I.M.O. Subsidiary Risk: NA
I.M.O. ID Number: NA
I.M.O. Packing Group: NA
Additional Information: This product may be shipped as part of a chemical kit composed of various compatible dangerous goods for analytical or testing purposes. This kit would have the following classification: Proper Shipping Name: Chemical Kit Hazard Class: 9 UN Number 3316

15. REGULATORY INFORMATION

U.S. Federal Regulations:

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O.S.H.A.: This product contains Cadmium and is regulated under 29CFR Subpart Z 1910.1027. This product meets the criteria for a hazardous substance as defined in the Hazard Communication Standard. (29 CFR 1910.1200)
E.P.A.:
S.A.R.A. Title III Section 311/312 Categorization (40 CFR 370): Immediate (Acute) Health Hazard Delayed (Chronic) Health Hazard
S.A.R.A. Title III Section 313 (40 CFR 372): This product contains a chemical(s) subject to the reporting requirements of Section 313 of Title III of SARA.
Cadmium
302 (EHS) TPQ (40 CFR 355): Not applicable
304 CERCLA RQ (40 CFR 302.4): Cadmium 10 lbs.
304 EHS RQ (40 CFR 355): Not applicable
Clean Water Act (40 CFR 116.4): Not applicable
RCRA: Contains RCRA regulated substances. See Section 13, EPA Waste ID Number.
C.P.S.C.: Not applicable
State Regulations:
California Prop. 65: WARNING - This product contains a chemical known to the State of California to cause cancer.
Identification of Prop. 65 Ingredient(s): Cadmium
Trade Secret Registry: Not applicable
National Inventories:
U.S. Inventory Status: All ingredients in this product are listed on the TSCA 8(b) Inventory (40 CFR 710).
TSCA CAS Number: Not applicable

16. OTHER INFORMATION

Intended Use: Determination of nitrate
References: 29 CFR 1900 - 1910 (Code of Federal Regulations - Labor). Air Contaminants, Federal Register, Vol. 54, No. 12. Thursday, January 19, 1989. pp. 2332-2983. TLV's Threshold Limit Values and Biological Exposure Indices for 1992-1993. American Conference of Governmental Industrial Hygienists, 1992. CCINFO RTECS. Canadian Centre for Occupational Health and Safety. Hamilton, Ontario Canada: 30 June 1993. Gosselin, R. E. et al. Clinical Toxicology of Commercial Products, 5th Ed. Baltimore: The Williams and Wilkins Co., 1984. IARC Monographs on the Evaluation of the Carcinogenic Risks to Humans. World Health Organization (Volumes 1-42) Supplement 7. France: 1987. List of Dangerous Substances Classified in Annex I of the EEC Directive (67/548) - Classification, Packaging and Labeling of Dangerous Substances, Amended July 1992. The Merck Index, 11th Ed. Rahway, New Jersey: Merck and Co., Inc., 1989. Technical Judgment. In-house information.
Revision Summary: European MSDS Only Updates in Heading(s) 2,

Legend:

NA - Not Applicable	w/w - weight/weight
ND - Not Determined	w/v - weight/volume
NV - Not Available	v/v - volume/volume

USER RESPONSIBILITY: Each user should read and understand this information and incorporate it in individual site safety programs in accordance with applicable hazard communication standards and regulations.

THE INFORMATION CONTAINED HEREIN IS BASED ON DATA CONSIDERED TO BE ACCURATE. HOWEVER, NO WARRANTY IS EXPRESSED OR IMPLIED REGARDING THE ACCURACY OF THESE DATA OR THE RESULTS TO BE OBTAINED FROM THE USE THEREOF.

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MATERIAL SAFETY DATA SHEET

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Name: Sulfide 1 Reagent
Catalog Number: 181632

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(970) 669-3050

Emergency Telephone Numbers:
(Medical and Transportation)
(303) 623-5716 24 Hour Service
(515)232-2533 8am - 4pm CST

MSDS Number: M00213
Chemical Name: Not applicable
CAS No.: Not applicable
Chemical Formula: Not applicable
Chemical Family: Not applicable
Hazard: Harmful if inhaled. Causes severe burns. Carcinogen.
Date of MSDS Preparation:
Day: 22
Month: 09
Year: 2004

2. COMPOSITION / INFORMATION ON INGREDIENTS

Demineralized Water
CAS No.: 7732-18-5
TSCA CAS Number: 7732-18-5
Percent Range: 35.0 - 45.0
Percent Range Units: weight / weight
LD50: None reported
LC50: None reported
TLV: Not established
PEL: Not established
Hazard: No effects anticipated.

Other component
CAS No.: Not applicable
TSCA CAS Number: Not applicable
Percent Range: 0.1 - 1.0
Percent Range Units: weight / weight
LD50: Not applicable
LC50: Not applicable
TLV: Not established
PEL: Not established
Hazard: Any ingredient(s) of this product listed as "Other component(s)" is not considered a health hazard to the user of this product.

Sulfuric Acid
CAS No.: 7664-93-9
TSCA CAS Number: 7664-93-9
Percent Range: 55.0 - 65.0
Percent Range Units: weight / weight
LD50: Oral rat LD50 = 2140 mg/kg.
LC50: Inhalation rat LC50 = 87 ppm/4 hr
TLV: 1 mg/m^3 (TWA); 3 mg/m^3 (STEL)
PEL: 1 mg/m^3
Hazard: Causes severe burns. Harmful if inhaled. Recognized carcinogen.

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3. HAZARDS IDENTIFICATION

Emergency Overview:
Appearance: Clear, colorless
Odor: None
CAUSES SEVERE BURNS HARMFUL IF INHALED

HMIS:
Health: 3
Flammability: 0
Reactivity: 2
Protective Equipment: X - See protective equipment, Section 8.
NFPA:
Health: 3
Flammability: 0
Reactivity: 2
Symbol: Water Reactive
Potential Health Effects:
Eye Contact: Causes severe burns
Skin Contact: Causes severe burns
Skin Absorption: None reported
Target Organs: None reported
Ingestion: Causes: severe burns May cause: nausea vomiting death circulatory disturbances rapid pulse and respirations diarrhea
Target Organs: None reported
Inhalation: Toxic. Causes: severe burns May cause: teeth erosion mouth soreness difficult breathing
Target Organs: Lungs
Medical Conditions Aggravated: Pre-existing: Eye conditions Respiratory conditions
Chronic Effects: Chronic overexposure may cause erosion of the teeth chronic irritation or inflammation of the lungs cancer
Cancer / Reproductive Toxicity Information:
This product does NOT contain any OSHA listed carcinogens.

An ingredient of this mixture is: IARC Group 1: Recognized Carcinogen
Sulfuric Acid - The IARC evaluation was based on exposure to the mist or vapor of concentrated sulfuric acid generated during chemical processes.
This product does NOT contain any NTP listed chemicals.

Additional Cancer / Reproductive Toxicity Information: None reported
Toxicologically Synergistic Products: None reported

4. FIRST AID

Eye Contact: Immediately flush eyes with water for 15 minutes. Call physician.
Skin Contact (First Aid): Wash skin with plenty of water for 15 minutes. Remove contaminated clothing. Call physician immediately.
Ingestion (First Aid): Do not induce vomiting. Give 1-2 glasses of water. Call physician immediately. Never give anything by mouth to an unconscious person.
Inhalation: Remove to fresh air. Give artificial respiration if necessary. Call physician.

5. FIRE FIGHTING MEASURES

Flammable Properties: Not Flammable, but reacts with most metals to form flammable hydrogen gas. During a fire, corrosive and toxic gases may be generated by thermal decomposition.

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Flash Point: Not applicable
Method: Not applicable
Flammability Limits:
Lower Explosion Limits: Not applicable
Upper Explosion Limits: Not applicable
Autoignition Temperature: Not applicable
Hazardous Combustion Products: This material will not burn. May emit acrid smoke and fumes.
Fire / Explosion Hazards: Contact with metals gives off hydrogen gas which is flammable May react violently with: strong bases water
Static Discharge: None reported.
Mechanical Impact: None reported
Extinguishing Media: Dry chemical. Do NOT use water.
Fire Fighting Instruction: As in any fire, wear self-contained breathing apparatus pressure-demand and full protective gear.

6. ACCIDENTAL RELEASE MEASURES

Spill Response Notice:
Only persons properly qualified to respond to an emergency involving hazardous substances may respond to a spill according to federal regulations (OSHA 29 CFR 1910.120(a)(v)) and per your company's emergency response plan and guidelines/procedures. See Section 13, Special Instructions for disposal assistance.
Containment Technique: Absorb spilled liquid with non-reactive sorbent material. Stop spilled material from being released to the environment. Dike large spills to keep spilled material from entering sewage and drainage systems or bodies of water.
Clean-up Technique: Remove all combustible materials from the spill area. Absorb spilled liquid with non-reactive sorbent material. Work in an approved fume hood. Working in small batches, dilute with excess water. Adjust to a pH between 6 and 9 with an alkali, such as soda ash or sodium bicarbonate. Filter to remove solids. Flush reacted material to the drain with a large excess of water. Decontaminate the area of the spill with a soap solution.
Evacuation Procedure: Evacuate local area (15 foot radius or as directed by your facility's emergency response plan) when: any quantity is spilled. If conditions warrant, increase the size of the evacuation.
Special Instructions (for accidental release): Mixture contains a component which is regulated as a water pollutant. Mixture contains a component which is regulated as hazardous waste.
304 EHS RQ (40 CFR 355): Sulfuric Acid - RQ 1000 lbs.
D.O.T. Emergency Response Guide Number: 137

7. HANDLING / STORAGE

Handling: Avoid contact with eyes skin clothing Do not breathe mist or vapors. Wash thoroughly after handling. Use with adequate ventilation. Maintain general industrial hygiene practices when using this product.
Storage: Store between 10° and 25°C. Keep container tightly closed when not in use. Keep away from: alkalies oxidizers reducers metals
Flammability Class: Not applicable

8. EXPOSURE CONTROLS / PROTECTIVE EQUIPMENT

Engineering Controls: Have an eyewash station nearby. Have a safety shower nearby. Use general ventilation to minimize exposure to mist, vapor or dust. Maintain general industrial hygiene practices when using this product.
Personal Protective Equipment:
Eye Protection: safety glasses with top and side shields
Skin Protection: disposable latex gloves lab coat
Inhalation Protection: adequate ventilation
Precautionary Measures: Avoid contact with: eyes skin clothing Do not breathe: mist/vapor Wash thoroughly after handling. Use with adequate ventilation. Keep away from: alkalies metals oxidizers reducers
TLV: Not established
PEL: Not established

9. PHYSICAL / CHEMICAL PROPERTIES

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Appearance: Clear, colorless
Physical State: Liquid
Molecular Weight: Not applicable
Odor: None
pH: < 0.5
Vapor Pressure: Not determined
Vapor Density (air = 1): Not determined
Boiling Point: ~ 100 °C; ~ 212 °F
Melting Point: Not applicable
Specific Gravity (water = 1): 1.500
Evaporation Rate (water = 1): Not determined
Volatile Organic Compounds Content: Not determined
Partition Coefficient (n-octanol / water): Not determined
Solubility:
Water: Miscible
Acid: Miscible
Other: Not determined
Metal Corrosivity:
Steel: 0.048 in/yr
Aluminum: Not determined

10. STABILITY / REACTIVITY

Chemical Stability: Stable when stored under proper conditions.
Conditions to Avoid: Exposure to light. Extreme temperatures Heating to decomposition.
Reactivity / Incompatibility: May react violently in contact with: acetic acid alkalies chlorosulfonic acid oxidizers reducers
Hazardous Decomposition: Contact with metals may release flammable hydrogen gas. Heating to decomposition releases toxic and/or corrosive fumes of: sulfur oxides
Hazardous Polymerization: Will not occur.

11. TOXICOLOGICAL INFORMATION

Product Toxicological Data:
LD50: None reported
LC50: None reported
Dermal Toxicity Data: None reported
Skin and Eye Irritation Data: None reported
Mutation Data: None reported
Reproductive Effects Data: None reported
Ingredient Toxicological Data: Sulfuric acid Oral rat LD50 = 2140 mg/kg; Inhalation rat LC50 = 347 ppm/1 hour

12. ECOLOGICAL INFORMATION

Product Ecological Information: –
No ecological data available for this product.
Ingredient Ecological Information: Sulfuric Acid: The 48-Hour TLm in flounder is 100-300 ppm.

13. DISPOSAL CONSIDERATIONS

EPA Waste ID Number: D002
Special Instructions (Disposal): Work in an approved fume hood. Dilute material with excess water making a weaker than 5% solution. Adjust to a pH between 6 and 9 with an alkali, such as soda ash or sodium bicarbonate. Open cold water tap completely, slowly pour the reacted material to the drain. Allow cold water to run for 5 minutes to completely flush the system.
Empty Containers: Rinse three times with an appropriate solvent. Dispose of empty container as normal trash.

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NOTICE (Disposal): These disposal guidelines are based on federal regulations and may be superseded by more stringent state or local requirements. Please consult your local environmental regulators for more information.

14. TRANSPORT INFORMATION

D.O.T.:
D.O.T. Proper Shipping Name: Sulphuric Acid Solution
–
DOT Hazard Class: 8
DOT Subsidiary Risk: NA
DOT ID Number: UN1830
DOT Packing Group: II
I.C.A.O.:
I.C.A.O. Proper Shipping Name: Sulphuric Acid Solution
--
ICAO Hazard Class: 8
ICAO Subsidiary Risk: NA
ICAO ID Number: UN1830
ICAO Packing Group: II
I.M.O.:
I.M.O. Proper Shipping Name: Sulphuric Acid Solution
–
I.M.O. Hazard Class: 8
I.M.O. Subsidiary Risk: NA
I.M.O. ID Number: UN1830
I.M.O. Packing Group: II
Additional Information: This product may be shipped as part of a chemical kit composed of various compatible dangerous goods for analytical or testing purposes. This kit would have the following classification: Proper Shipping Name: Chemical Kit Hazard Class: 9 UN Number 3316

15. REGULATORY INFORMATION

U.S. Federal Regulations:
O.S.H.A.: This product meets the criteria for a hazardous substance as defined in the Hazard Communication Standard. (29 CFR 1910.1200)
E.P.A.:
S.A.R.A. Title III Section 311/312 Categorization (40 CFR 370): Reactive Immediate (Acute) Health Hazard Delayed (Chronic) Health Hazard
S.A.R.A. Title III Section 313 (40 CFR 372): This product contains a chemical(s) subject to the reporting requirements of Section 313 of Title III of SARA.
Sulfuric acid
302 (EHS) TPQ (40 CFR 355): 1000 lbs. Sulfuric Acid
304 CERCLA RQ (40 CFR 302.4): 1000 lbs. Sulfuric Acid
304 EHS RQ (40 CFR 355): Sulfuric Acid - RQ 1000 lbs.
Clean Water Act (40 CFR 116.4): Sulfuric acid - RQ 1000 lbs.
RCRA: Contains RCRA regulated substances. See Section 13, EPA Waste ID Number.
C.P.S.C.: The label for this product bears the signal word "POISON" because the concentration of Sulfuric Acid in the product is greater than/equal to 10%.
State Regulations:
California Prop. 65: No Prop. 65 listed chemicals are present in this product.
Identification of Prop. 65 Ingredient(s): Not applicable
Trade Secret Registry: Not applicable
National Inventories:
U.S. Inventory Status: All ingredients in this product are listed on the TSCA 8(b) Inventory (40 CFR 710).
TSCA CAS Number: Not applicable

16. OTHER INFORMATION

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Intended Use: Determination of sulfides

References: Technical Judgment. In-house information. List of Dangerous Substances Classified in Annex I of the EEC Directive (67/548) - Classification, Packaging and Labeling of Dangerous Substances, Amended July 1992. CCINFO RTECS. Canadian Centre for Occupational Health and Safety. Hamilton, Ontario Canada: 30 June 1993. Fire Protection Guide on Hazardous Materials, 10th Ed. Quincy, MA: National Fire Protection Fire Protection Guide on Hazardous Materials, 10th Ed. Quincy, MA: National Fire Protection Association, 1991. Sax, N. Irving. Dangerous Properties of Industrial Materials, 7th Ed. New York: Van Nostrand Reinhold Co., 1989. Air Contaminants, Federal Register, Vol. 54, No. 12, Thursday, January 19, 1989. pp. 2332-2983. TLV's Threshold Limit Values and Biological Exposure Indices for 1992-1993. American Conference of Governmental Industrial Hygienists, 1992. IARC Monographs on the Evaluation of the Carcinogenic Risks to Humans. World Health Organization (Volumes 1-42) Supplement 7. France: 1987.

Revision Summary: Updates in Section(s) 14,

Legend:

NA - Not Applicable	w/w - weight/weight
ND - Not Determined	w/v - weight/volume
NV - Not Available	v/v - volume/volume

USER RESPONSIBILITY: Each user should read and understand this information and incorporate it in individual site safety programs in accordance with applicable hazard communication standards and regulations.

THE INFORMATION CONTAINED HEREIN IS BASED ON DATA CONSIDERED TO BE ACCURATE. HOWEVER, NO WARRANTY IS EXPRESSED OR IMPLIED REGARDING THE ACCURACY OF THESE DATA OR THE RESULTS TO BE OBTAINED FROM THE USE THEREOF.

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MATERIAL SAFETY DATA SHEET

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Name: Sulfide 2 Reagent
Catalog Number: 181732

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P.O.Box 389
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Emergency Telephone Numbers:
(Medical and Transportation)
(303) 623-5716 24 Hour Service
(515)232-2533 8am - 4pm CST

MSDS Number: M00435
Chemical Name: Not applicable
CAS No.: Not applicable
Chemical Formula: Not applicable
Chemical Family: Not applicable
Hazard: Carcinogen. Experimental mutagen. Experimental teratogen. May cause allergic reaction.
Date of MSDS Preparation:
Day: 03
Month: December
Year: 2001

2. COMPOSITION / INFORMATION ON INGREDIENTS

Demineralized Water
CAS No.: 7732-18-5
TSCA CAS Number: 7732-18-5
Percent Range: > 99.0
Percent Range Units: weight / weight
LD50: None reported
LC50: None reported
TLV: Not established
PEL: Not established
Hazard: No effects anticipated.

Potassium Dichromate
CAS No.: 7778-50-9
TSCA CAS Number: 7778-50-9
Percent Range: 0.1 - 1.0
Percent Range Units: weight / weight
LD50: Oral mouse LD_{50} = 190 mg/kg; Oral human (child) LDLo = 26 mg/kg.
LC50: None reported.
TLV: 0.05 mg Cr^6/m^3 Water-soluble; 0.01 mg Cr^6/m^3 insoluble compounds
PEL: 0.5 mg/m³ (Cr^{+6}), Ceiling; Proposed PEL: 1 µg Cr^6/m^3, TWA (Oct 4 FR Pg 59307).
Hazard: Toxic. Causes burns. May cause allergic reaction. Carcinogen. Experimental mutagen. Experimental teratogen. Oxidizer.

3. HAZARDS IDENTIFICATION

Emergency Overview:
Appearance: Clear, orange
Odor: None

MAY CAUSE ALLERGIC SKIN REACTION CANCER HAZARD CONTAINS MATERIAL WHICH CAN CAUSE CANCER

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HMIS:
Health: 4
Flammability: 0
Reactivity: 0
Protective Equipment: X - See protective equipment, Section 8.
NFPA:
Health: 1
Flammability: 0
Reactivity: 0
Symbol: Not applicable
Potential Health Effects:
Eye Contact: May cause irritation
Skin Contact: May cause irritation May cause allergic reaction
Skin Absorption: Will be absorbed through the skin. Effects similar to those of ingestion
Target Organs: None reported
Ingestion: May cause: abdominal pain vomiting dizziness thirst fever coma liver damage
Target Organs: None reported
Inhalation: May cause: respiratory tract irritation
Target Organs: None reported
Medical Conditions Aggravated: Allergies or sensitivity to chromates or chromic acid. Pre-existing: Skin conditions
Chronic Effects: Chromate and dichromate salts may cause ulceration and perforation of the nasal septum, severe liver damage, central nervous system effects, and lung cancer.
Cancer / Reproductive Toxicity Information:
O.S.H.A. Listed: No
Hexavalent Chromium (Cr^6) Proposal: 4 Oct 2004 FR Pg 59351.
An ingredient of this mixture is: IARC Group 1: Recognized Carcinogen
Hexavalent Chromium Compounds
An ingredient of this mixture is: NTP Listed Group 1: Recognized Carcinogen
Hexavalent Chromium Compounds
Additional Cancer / Reproductive Toxicity Information: Contains: an experimental mutagen. an experimental teratogen.
Toxicologically Synergistic Products: None reported

4. FIRST AID

Eye Contact: Immediately flush eyes with water for 15 minutes. Call physician.
Skin Contact (First Aid): Wash skin with plenty of water. Call physician if irritation develops.
Ingestion (First Aid): Give large quantities of water. Induce vomiting using syrup of ipecac or by sticking finger down throat. Never give anything by mouth to an unconscious person. Call physician immediately.
Inhalation: None required.

5. FIRE FIGHTING MEASURES

Flammable Properties: Material will not burn.
Flash Point: Not determined.
Method: Not applicable
Flammability Limits:
Lower Explosion Limits: Not applicable
Upper Explosion Limits: Not applicable
Autoignition Temperature: Not determined.
Hazardous Combustion Products: This material will not burn.
Fire / Explosion Hazards: May react violently with: hydrazine hydroxylamine reducers
Static Discharge: None reported.
Mechanical Impact: None reported
Extinguishing Media: Water. Use media appropriate to surrounding fire conditions

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Fire Fighting Instruction: As in any fire, wear self-contained breathing apparatus pressure-demand and full protective gear. Evacuate area and fight fire from a safe distance. Water runoff can cause environmental damage. Dike and collect water used to fight fire.

6. ACCIDENTAL RELEASE MEASURES

Spill Response Notice:
Only persons properly qualified to respond to an emergency involving hazardous substances may respond to a spill according to federal regulations (OSHA 29 CFR 1910.120(a)(v)) and per your company's emergency response plan and guidelines/procedures. See Section 13, Special Instructions for disposal assistance.
Containment Technique: Releases of this material may contaminate the environment. Stop spilled material from being released to the environment.
Clean-up Technique: Cover spilled material with an alkali, such as soda ash or sodium bicarbonate. Scoop up slurry into a large beaker. Adjust to a pH between 6 and 9 with an alkali, such as soda ash or sodium bicarbonate. Dispose of material in an E.P.A. approved hazardous waste facility. Decontaminate the area of the spill with a soap solution.
Evacuation Procedure: Evacuate as needed to perform spill clean-up. If conditions warrant, increase the size of the evacuation.
Special Instructions (for accidental release): Mixture contains a component which is regulated as hazardous waste. Mixture contains a component which is regulated as a hazardous air pollutant. Mixture contains a component which is regulated as a water pollutant.
304 EHS RQ (40 CFR 355): Not applicable
D.O.T. Emergency Response Guide Number: Not applicable

7. HANDLING / STORAGE

Handling: Avoid contact with eyes skin Do not breathe mist or vapors. Wash thoroughly after handling. Maintain general industrial hygiene practices when using this product.
Storage: Keep container tightly closed when not in use. Store in a cool, dry place. Protect from: light
Flammability Class: Not applicable

8. EXPOSURE CONTROLS / PROTECTIVE EQUIPMENT

Engineering Controls: Maintain general industrial hygiene practices when using this product.
Personal Protective Equipment:
Eye Protection: safety glasses with top and side shields
Skin Protection: disposable latex gloves lab coat
Inhalation Protection: adequate ventilation
Precautionary Measures: Avoid contact with: eyes skin Do not breathe: mist/vapor Wash thoroughly after handling. Use with adequate ventilation.
TLV: Not established.
PEL: Not established.

9. PHYSICAL / CHEMICAL PROPERTIES

Appearance: Clear, orange
Physical State: Liquid
Molecular Weight: Not applicable
Odor: None
pH: 4.2
Vapor Pressure: Not determined.
Vapor Density (air = 1): Not determined.
Boiling Point: ~ 100°C (~212°F)
Melting Point: Not applicable
Specific Gravity (water = 1): 0.987
Evaporation Rate (water = 1): Not determined.
Volatile Organic Compounds Content: None.
Partition Coefficient (n-octanol / water): Not applicable
Solubility:

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Water: Miscible.
Acid: Miscible.
Other: Not determined.
Metal Corrosivity:
Steel: Not determined.
Aluminum: Not determined.

10. STABILITY / REACTIVITY

Chemical Stability: Stable when stored under proper conditions.
Conditions to Avoid: Extreme temperatures
Reactivity / Incompatibility: May react violently in contact with: hydrazine hydroxylamine reducers
Hazardous Decomposition: No hazardous decomposition products known.
Hazardous Polymerization: Will not occur.

11. TOXICOLOGICAL INFORMATION

Product Toxicological Data:
LD50: None reported.
LC50: None reported.
Dermal Toxicity Data: None reported.
Skin and Eye Irritation Data: None reported.
Mutation Data: None reported.
Reproductive Effects Data: None reported.
Ingredient Toxicological Data: Potassium Dichromate: Oral mouse LD_{50} = 190 mg/kg; Oral human (child) LDLo = 26 mg/kg; Mutation and Reproductive Effects data reported in RTECS.

12. ECOLOGICAL INFORMATION

Product Ecological Information: --
No ecological data available for this product.
Ingredient Ecological Information: --
No ecological data available for the ingredients of this product.

13. DISPOSAL CONSIDERATIONS

EPA Waste ID Number: D007
Special Instructions (Disposal): Dispose of material in an E.P.A. approved hazardous waste facility.
Empty Containers: Rinse three times with an appropriate solvent. Dispose of empty container as normal trash. Rinsate from empty containers may contain sufficient product to require disposal as hazardous waste.
NOTICE (Disposal): These disposal guidelines are based on federal regulations and may be superseded by more stringent state or local requirements. Please consult your local environmental regulators for more information.

14. TRANSPORT INFORMATION

D.O.T.:
D.O.T. Proper Shipping Name: Not Currently Regulated
—
DOT Hazard Class: NA
DOT Subsidiary Risk: NA
DOT ID Number: NA
DOT Packing Group: NA
I.C.A.O.:
I.C.A.O. Proper Shipping Name: Not Currently Regulated
—
ICAO Hazard Class: NA

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ICAO Subsidiary Risk: NA
ICAO ID Number: NA
ICAO Packing Group: NA
I.M.O.:
I.M.O. Proper Shipping Name: Not Currently Regulated
I.M.O. Hazard Class: NA
I.M.O. Subsidiary Risk: NA
I.M.O. ID Number: NA
I.M.O. Packing Group: NA
Additional Information: This product may be shipped as part of a chemical kit composed of various compatible dangerous goods for analytical or testing purposes. This kit would have the following classification: Proper Shipping Name: Chemical Kit Hazard Class: 9 UN Number 3316

15. REGULATORY INFORMATION

U.S. Federal Regulations:
O.S.H.A.: This product meets the criteria for a hazardous substance as defined in the Hazard Communication Standard. (29 CFR 1910.1200)
E.P.A.:
S.A.R.A. Title III Section 311/312 Categorization (40 CFR 370): Delayed (Chronic) Health Hazard Fire Hazard
S.A.R.A. Title III Section 313 (40 CFR 372): This product contains a chemical(s) subject to the reporting requirements of Section 313 of Title III of SARA.
Chromium Compounds.
302 (EHS) TPQ (40 CFR 355): Not applicable
304 CERCLA RQ (40 CFR 302.4): Potassium bichromate: 10 lbs.
304 EHS RQ (40 CFR 355): Not applicable
Clean Water Act (40 CFR 116.4): Potassium bichromate - RQ = 10 lbs. (4.54 kgs.)
RCRA: Contains RCRA regulated substances. See Section 13, EPA Waste ID Number.
C.P.S.C.: Not applicable
State Regulations:
California Prop. 65: WARNING - This product contains a chemical known to the State of California to cause cancer.
Identification of Prop. 65 Ingredient(s): Chromium (hexavalent compounds)
Trade Secret Registry: Not applicable
National Inventories:
U.S. Inventory Status: All ingredients in this product are listed on the TSCA 8(b) Inventory (40 CFR 710).
TSCA CAS Number: Not applicable

16. OTHER INFORMATION

Intended Use: Determination of sulfides
References: 29 CFR 1900 - 1910 (Code of Federal Regulations - Labor). Air Contaminants, Federal Register, Vol. 54, No. 12. Thursday, January 19, 1989. pp. 2332-2983. CCINFO RTECS. Canadian Centre for Occupational Health and Safety. Hamilton, Ontario Canada: 30 June 1993. Gosselin, R. E. et al. Clinical Toxicology of Commercial Products, 5th Ed. Baltimore: The Williams and Wilkins Co., 1984. IARC Monographs on the Evaluation of the Carcinogenic Risks to Humans. World Health Organization (Volumes 1-42) Supplement 7. France: 1987. List of Dangerous Substances Classified in Annex I of the EEC Directive (67/548) - Classification, Packaging and Labeling of Dangerous Substances, Amended July 1992. Sixth Annual Report on Carcinogens, 1991. U.S. Department of Health and Human Services. Rockville, MD: Technical Resources, Inc. 1991. Technical Judgment. The Merck Index, 11th Ed. Rahway, New Jersey: Merck and Co., Inc., 1989. TLV's Threshold Limit Values and Biological Exposure Indices for 1992-1993. American Conference of Governmental Industrial Hygienists, 1992. Vendor Information.
Revision Summary: Updates in Section(s) 14,

Legend:

NA - Not Applicable	w/w - weight/weight
ND - Not Determined	w/v - weight/volume

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NV - Not Available v/v - volume/volume

USER RESPONSIBILITY: Each user should read and understand this information and incorporate it in individual site safety programs in accordance with applicable hazard communication standards and regulations.

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MATERIAL SAFETY DATA SHEET

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Name: NitriVer ® 3 Nitrite Reagent
Catalog Number: 2107169

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(970) 669-3050

Emergency Telephone Numbers:
(Medical and Transportation)
(303) 623-5716 24 Hour Service
(515)232-2533 8am - 4pm CST

MSDS Number: M00055
Chemical Name: Not applicable
CAS No.: Not applicable
Chemical Formula: Not applicable
Chemical Family: Not applicable
Hazard: Causes eye burns.
Date of MSDS Preparation:
Day: 23
Month: 09
Year: 2004

2. COMPOSITION / INFORMATION ON INGREDIENTS

Chromatropic Acid, Disodium salt
CAS No.: 129-96-4
TSCA CAS Number: 129-96-4
Percent Range: 1.0 - 5.0
Percent Range Units: weight / weight
LD50: Oral rat LD50 > 5000 mg/kg
LC50: None reported
TLV: Not established
PEL: Not established
Hazard: May cause irritation.

Sodium Sulfanilate
CAS No.: 515-74-2
TSCA CAS Number: 515-74-2
Percent Range: 5.0 - 15.0
Percent Range Units: weight / weight
LD50: None reported
LC50: None reported
TLV: Not established
PEL: Not established
Hazard: Toxic properties unknown. May cause irritation.

Potassium Pyrosulfate
CAS No.: 7790-62-7
TSCA CAS Number: 7790-62-7
Percent Range: 1.0 - 10.0
Percent Range Units: weight / weight
LD50: Oral rat LD50 = 2340 mg/kg
LC50: None reported
TLV: Not established
PEL: Not established
Hazard: Causes eye burns.

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Potassium Phosphate, Monobasic
CAS No.: 7778-77-0
TSCA CAS Number: 7778-77-0
Percent Range: 75.0 - 85.0
Percent Range Units: weight / weight
LD50: Oral rat LD50 = 7100 mg/kg
LC50: None reported
TLV: Not established
PEL: Not established
Hazard: May cause irritation.

1,2-Cyclohexanediaminetetraacetic Acid Trisodium Salt
CAS No.: 36679-96-6
TSCA CAS Number: 36679-96-6
Percent Range: 1.0 - 5.0
Percent Range Units: weight / weight
LD50: None reported
LC50: None reported
TLV: Not established
PEL: Not established
Hazard: Toxic properties unknown. May cause irritation.

3. HAZARDS IDENTIFICATION

Emergency Overview:
Appearance: White powder
Odor: Not determined
CAUSES EYE BURNS MAY CAUSE SKIN AND RESPIRATORY TRACT IRRITATION

HMIS:
Health: 3
Flammability: 0
Reactivity: 0
Protective Equipment: X - See protective equipment, Section 8.
NFPA:
Health: 2
Flammability: 0
Reactivity: 0
Symbol: Not applicable
Potential Health Effects:
Eye Contact: Causes eye burns.
Skin Contact: May cause irritiation
Skin Absorption: None reported
Target Organs: None reported
Ingestion: May cause: irritation of the mouth and esophagus Very large doses may cause: gastrointestinal disturbances cardiac depression kidney damage
Target Organs: Heart Kidneys
Inhalation: May cause: irritation of nose and throat
Target Organs: None reported
Medical Conditions Aggravated: Pre-existing: Eye conditions Kidney conditions Central nervous system diseases
Chronic Effects: None reported
Cancer / Reproductive Toxicity Information:
This product does NOT contain any OSHA listed carcinogens.

This product does NOT contain any IARC listed chemicals.

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This product does NOT contain any NTP listed chemicals.

Additional Cancer / Reproductive Toxicity Information: None reported
Toxicologically Synergistic Products: None reported

4. FIRST AID

Eye Contact: Immediately flush eyes with water for 15 minutes. Call physician.
Skin Contact (First Aid): Wash skin with soap and plenty of water. Call physician if irritation develops.
Ingestion (First Aid): Do not induce vomiting. Give 1-2 glasses of water. Call physician immediately. Never give anything by mouth to an unconscious person.
Inhalation: Remove to fresh air. Give artificial respiration if necessary. Call physician.

5. FIRE FIGHTING MEASURES

Flammable Properties: During a fire, this product decomposes to form toxic gases.
Flash Point: Not applicable
Method: Not applicable
Flammability Limits:
Lower Explosion Limits: Not applicable
Upper Explosion Limits: Not applicable
Autoignition Temperature: Not applicable
Hazardous Combustion Products: Toxic fumes of: phosphorus oxides carbon monoxide, carbon dioxide.
Fire / Explosion Hazards: None reported
Static Discharge: None reported.
Mechanical Impact: None reported
Extinguishing Media: Use media appropriate to surrounding fire conditions
Fire Fighting Instruction: As in any fire, wear self-contained breathing apparatus pressure-demand and full protective gear.

6. ACCIDENTAL RELEASE MEASURES

Spill Response Notice:
Only persons properly qualified to respond to an emergency involving hazardous substances may respond to a spill according to federal regulations (OSHA 29 CFR 1910.120(a)(v)) and per your company's emergency response plan and guidelines/procedures. See Section 13, Special Instructions for disposal assistance.
Containment Technique: Stop spilled material from being released to the environment.
Clean-up Technique: Scoop up spilled material into a large beaker and dissolve with water. Adjust to a pH between 6 and 9 with an alkali, such as soda ash or sodium bicarbonate. Flush the spilled material to the drain with a large excess of water.
Evacuation Procedure: Evacuate local area (15 foot radius or as directed by your facility's emergency response plan) when: any quantity is spilled.
Special Instructions (for accidental release): Not applicable
304 EHS RQ (40 CFR 355): Not applicable
D.O.T. Emergency Response Guide Number: None

7. HANDLING / STORAGE

Handling: Avoid contact with eyes skin Do not breathe dust. Wash thoroughly after handling. Maintain general industrial hygiene practices when using this product.
Storage: Protect from: light heat moisture
Flammability Class: Not applicable

8. EXPOSURE CONTROLS / PROTECTIVE EQUIPMENT

Engineering Controls: Have an eyewash station nearby. Maintain general industrial hygiene practices when using this product.

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Personal Protective Equipment:
Eye Protection: safety glasses with top and side shields
Skin Protection: disposable latex gloves lab coat
Inhalation Protection: adequate ventilation
Precautionary Measures: Avoid contact with: eyes skin Do not breathe: dust Wash thoroughly after handling. Protect from: light heat moisture
TLV: Not established
PEL: Not established

9. PHYSICAL / CHEMICAL PROPERTIES

Appearance: White powder
Physical State: Solid
Molecular Weight: Not applicable
Odor: Not determined
pH: of 5% solution = 3.2
Vapor Pressure: Not applicable
Vapor Density (air = 1): Not applicable
Boiling Point: Not applicable
Melting Point: 224°C (435°F)
Specific Gravity (water = 1): 3.12
Evaporation Rate (water = 1): Not applicable
Volatile Organic Compounds Content: Not applicable
Partition Coefficient (n-octanol / water): Not applicable
Solubility:
Water: Soluble
Acid: Not determined
Other: Not determined
Metal Corrosivity:
Steel: 0.057 in/yr
Aluminum: 0.00 in/yr

10. STABILITY / REACTIVITY

Chemical Stability: Stable when stored under proper conditions.
Conditions to Avoid: Excess moisture Extreme temperatures
Reactivity / Incompatibility: None reported
Hazardous Decomposition: Toxic fumes of: phosphorus oxides carbon dioxide carbon monoxide
Hazardous Polymerization: Will not occur.

11. TOXICOLOGICAL INFORMATION

Product Toxicological Data:
LD50: None reported
LC50: None reported
Dermal Toxicity Data: None reported
Skin and Eye Irritation Data: None reported
Mutation Data: None reported
Reproductive Effects Data: None reported
Ingredient Toxicological Data: Chromatropic Acid: Oral rat LD50: >5000 mg/kg, Potassium Phosphate Monobasic: Oral rat LD50 = 7100 mg/kg, Potassium Pyrosulfate: Oral rat LD50 = 2340 mg/kg

12. ECOLOGICAL INFORMATION

Product Ecological Information: –
No ecological data available for this product.
Ingredient Ecological Information: –

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No ecological data available for the ingredients of this product.

13. DISPOSAL CONSIDERATIONS

EPA Waste ID Number: None
Special Instructions (Disposal): Dilute material with excess water making a weaker than 5% solution. Adjust to a pH between 6 and 9 with an alkali, such as soda ash or sodium bicarbonate. Open cold water tap completely, slowly pour the reacted material to the drain.
Empty Containers: Rinse three times with an appropriate solvent. Dispose of empty container as normal trash.
NOTICE (Disposal): These disposal guidelines are based on federal regulations and may be superseded by more stringent state or local requirements. Please consult your local environmental regulators for more information.

14. TRANSPORT INFORMATION

D.O.T.:
D.O.T. Proper Shipping Name: Not Currently Regulated
DOT Hazard Class: NA
DOT Subsidiary Risk: NA
DOT ID Number: NA
DOT Packing Group: NA
I.C.A.O.:
I.C.A.O. Proper Shipping Name: Not Currently Regulated
ICAO Hazard Class: NA
ICAO Subsidiary Risk: NA
ICAO ID Number: NA
ICAO Packing Group: NA
I.M.O.:
I.M.O. Proper Shipping Name: Not Currently Regulated
I.M.O. Hazard Class: NA
I.M.O. Subsidiary Risk: NA
I.M.O. ID Number: NA
I.M.O. Packing Group: NA
Additional Information: This product may be shipped as part of a chemical kit composed of various compatible dangerous goods for analytical or testing purposes. This kit would have the following classification: Proper Shipping Name: Chemical Kit Hazard Class: 9 UN Number 3316

15. REGULATORY INFORMATION

U.S. Federal Regulations:
O.S.H.A.: This product meets the criteria for a hazardous substance as defined in the Hazard Communication Standard (29 CFR 1910.1200)
E.P.A.:
S.A.R.A. Title III Section 311/312 Categorization (40 CFR 370): Immediate (Acute) Health Hazard
S.A.R.A. Title III Section 313 (40 CFR 372): This product does NOT contain any chemical subject to the reporting requirements of Section 313 of Title III of SARA.
302 (EHS) TPQ (40 CFR 355): Not applicable
304 CERCLA RQ (40 CFR 302.4): Not applicable
304 EHS RQ (40 CFR 355): Not applicable
Clean Water Act (40 CFR 116.4): Not applicable
RCRA: Contains no RCRA regulated substances.
C.P.S.C.: Not applicable
State Regulations:
California Prop. 65: No Prop. 65 listed chemicals are present in this product.
Identification of Prop. 65 Ingredient(s): None

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Trade Secret Registry: Not applicable
National Inventories:
U.S. Inventory Status: This product contains a chemical(s) exempt from the TSCA 8(b) Inventory due to a Low Volume Exemption held by Hach Company.
TSCA CAS Number: Not applicable
1,2-Cyclohexanediaminetetraacetic Acid Trisodium Salt. This chemical may only be used as a chelating reagent for chemical reactions.

16. OTHER INFORMATION

Intended Use: Determination of nitrite
References: 29 CFR 1900 - 1910 (Code of Federal Regulations - Labor). Air Contaminants, Federal Register, Vol. 54, No. 12. Thursday, January 19, 1989. pp. 2332-2983. Fire Protection Guide on Hazardous Materials, 10th Ed. Quincy, MA: National Fire Protection Fire Protection Guide on Hazardous Materials, 10th Ed. Quincy, MA: National Fire Protection Association, 1991. In-house information. Technical Judgment. TLV's Threshold Limit Values and Biological Exposure Indices for 1992-1993. American Conference of Governmental Industrial Hygienists, 1992.
Revision Summary: Updates in Section(s) 14.

Legend:

NA - Not Applicable	w/w - weight/weight
ND - Not Determined	w/v - weight/volume
NV - Not Available	v/v - volume/volume

USER RESPONSIBILITY: Each user should read and understand this information and incorporate it in individual site safety programs in accordance with applicable hazard communication standards and regulations.

THE INFORMATION CONTAINED HEREIN IS BASED ON DATA CONSIDERED TO BE ACCURATE. HOWEVER, NO WARRANTY IS EXPRESSED OR IMPLIED REGARDING THE ACCURACY OF THESE DATA OR THE RESULTS TO BE OBTAINED FROM THE USE THEREOF.

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MATERIAL SAFETY DATA SHEET

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Name: Ammonia Cyanurate Reagent Powder Pillows
Catalog Number: 2395566

Hach Company
P.O.Box 389
Loveland, CO USA 80539
(970) 669-3050

Emergency Telephone Numbers:
(Medical and Transportation)
(303) 623-5716 24 Hour Service
(515)232-2533 8am - 4pm CST

MSDS Number: M00128
Chemical Name: Not Applicable
CAS No.: Not Applicable
Chemical Formula: Not Applicable
Chemical Family: Not applicable
Hazard: Causes burns.
Date of MSDS Preparation:
Day: 20
Month: June
Year: 2003

2. COMPOSITION / INFORMATION ON INGREDIENTS

Sodium Dichloroisocyanurate
CAS No.: 2893-78-9
TSCA CAS Number: 2893-78-9
Percent Range: 1.0 - 5.0
Percent Range Units: weight / weight
LD50: Oral rat LD50 = 1400 mg/kg; Oral human LDLo = 3570 mg/kg
LC50: None reported
TLV: Not established
PEL: Not established
Hazard: Oxidizer. Causes eye burns.

Lithium Hydroxide, Anhydrous
CAS No.: 1310-65-2
TSCA CAS Number: 1310-65-2
Percent Range: 1.0 - 5.0
Percent Range Units: weight / weight
LD50: Oral rat LD50 = 225 mg/kg
LC50: Inhalation rat LC50 = 980 mg/m^3/4H
TLV: STEL 2 mg/m^3 (ceiling)
PEL: 2 mg/m^3
Hazard: Toxic. Causes severe burns.

Sodium Citrate
CAS No.: 68-04-2
TSCA CAS Number: 68-04-2
Percent Range: 80.0 - 90.0
Percent Range Units: weight / weight
LD50: Oral rat LD50 >8 g/Kg
LC50: None reported
TLV: Not established
PEL: Not established
Hazard: May cause irritation.

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Sodium Tartrate
CAS No.: 6106-24-7
TSCA CAS Number: 868-18-8
Percent Range: 5.0 - 15.0
Percent Range Units: weight / weight
LD50: Oral rabbit LD50 = 5290 mg/kg
LC50: None reported
TLV: Not established
PEL: Not established
Hazard: May cause irritation.

3. HAZARDS IDENTIFICATION

Emergency Overview:
Appearance: White powder
Odor: Chlorine
CAUSES BURNS HARMFUL IF SWALLOWED
MAY CAUSE KIDNEY OR LIVER DAMAGE BASED ON ANIMAL DATA

HMIS:
Health: 3
Flammability: 1
Reactivity: 1
Protective Equipment: X - See protective equipment, Section 8.
NFPA:
Health: 2
Flammability: 1
Reactivity: 1
Symbol: Not applicable
Potential Health Effects:
Eye Contact: Causes eye burns.
Skin Contact: Causes burns.
Skin Absorption: None reported
Target Organs: None reported
Ingestion: Causes: burns May cause: dizziness nausea kidney damage liver damage
Target Organs: Liver Kidneys Central nervous system Bone marrow
Inhalation: Causes: burns May cause: shortness of breath coughing
Target Organs: None reported
Medical Conditions Aggravated: Pre-existing: Eye conditions Skin conditions Respiratory conditions
Chronic Effects: Lithium compounds have been implicated in development of aplastic anemia. Signs of lithium poisoning include dehydration, extreme weight loss, fine tremor of hands, nausea, vomiting and diarrhea, Chronic overexposure may cause central nervous system effects kidney damage liver damage
Cancer / Reproductive Toxicity Information:
This product does NOT contain any OSHA listed carcinogens.

This product does NOT contain any IARC listed chemicals.

This product does NOT contain any NTP listed chemicals.

Additional Cancer / Reproductive Toxicity Information: None reported
Toxicologically Synergistic Products: None reported

4. FIRST AID

Eye Contact: Immediately flush eyes with water for 15 minutes. Call physician.
Skin Contact (First Aid): Wash skin with soap and plenty of water for 15 minutes. Remove contaminated clothing. Call physician immediately.

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Ingestion (First Aid): Do not induce vomiting. Give 1-2 glasses of water. Call physician immediately. Never give anything by mouth to an unconscious person.
Inhalation: Remove to fresh air. Give artificial respiration if necessary. Call physician.

5. FIRE FIGHTING MEASURES

Flammable Properties: During a fire, irritating and highly toxic gases may be generated by thermal decomposition.
Flash Point: Not applicable
Method: Not applicable
Flammability Limits:
Lower Explosion Limits: Not applicable
Upper Explosion Limits: Not applicable
Autoignition Temperature: Not determined
Hazardous Combustion Products: May emit toxic and corrosive fumes.
Fire / Explosion Hazards: Not combustible.
Static Discharge: None reported.
Mechanical Impact: None reported
Extinguishing Media: Dry chemical. Carbon dioxide Water.
Fire Fighting Instruction: As in any fire, wear self-contained breathing apparatus pressure-demand and full protective gear.

6. ACCIDENTAL RELEASE MEASURES

Spill Response Notice:
Only persons properly qualified to respond to an emergency involving hazardous substances may respond to a spill according to federal regulations (OSHA 29 CFR 1910.120(a)(v)) and per your company's emergency response plan and guidelines/procedures. See Section 13, Special Instructions for disposal assistance.
Containment Technique: Cover spilled solid material with sand or other inert material. Stop spilled material from being released to the environment.
Clean-up Technique: Scoop up spilled material into a large beaker and dissolve with water. Adjust to a pH between 6 and 9 with an acid, such as sulfuric or citric. Flush reacted material to the drain with a large excess of water. Decontaminate the area of the spill with a soap solution.
Evacuation Procedure: Evacuate local area (15 foot radius or as directed by your facility's emergency response plan) when: any quantity is spilled. If conditions warrant, increase the size of the evacuation.
Special Instructions (for accidental release): Not applicable
304 EHS RQ (40 CFR 355): Not applicable
D.O.T. Emergency Response Guide Number: 154

7. HANDLING / STORAGE

Handling: Avoid contact with eyes skin clothing Do not breathe dust. Wash thoroughly after handling. Maintain general industrial hygiene practices when using this product.
Storage: Protect from: heat moisture Store away from: acids / acid fumes.
Flammability Class: Not applicable

8. EXPOSURE CONTROLS / PROTECTIVE EQUIPMENT

Engineering Controls: Have an eyewash station nearby. Have a safety shower nearby. Use a fume hood to avoid exposure to dust, mist or vapor. Maintain general industrial hygiene practices when using this product.
Personal Protective Equipment:
Eye Protection: safety glasses with top and side shields
Skin Protection: disposable latex gloves lab coat
Inhalation Protection: adequate ventilation
Precautionary Measures: Avoid contact with: eyes skin clothing Do not breathe: dust Wash thoroughly after handling. Keep away from: acids/acid fumes metals
TLV: Not established
PEL: Not established

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MATERIAL SAFETY DATA SHEET

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Name: Ammonia Salicylate Reagent Powder Pillows
Catalog Number: 2395366

Hach Company
P.O.Box 389
Loveland, CO USA 80539
(970) 669-3050

Emergency Telephone Numbers:
(Medical and Transportation)
(303) 623-5716 24 Hour Service
(515)232-2533 8am - 4pm CST

MSDS Number: M00127
Chemical Name: Not applicable
CAS No.: Not applicable
Chemical Formula: Not applicable
Chemical Family: Not applicable
Hazard: May cause irritation. Harmful if swallowed
Date of MSDS Preparation:
Day: 22
Month: 09
Year: 2004

2. COMPOSITION / INFORMATION ON INGREDIENTS

Sodium Salicylate
CAS No.: 54-21-7
TSCA CAS Number: 54-21-7
Percent Range: 40.0 - 50.0
Percent Range Units: weight / weight
LD50: Oral rat LD_{50} = 1200 mg/kg; Oral mouse LD_{50} = 540 mg/kg; Oral rabbit LD_{50} = 1700 mg/kg.
LC50: None reported.
TLV: Not established.
PEL: Not established.
Hazard: May cause irritation. Experimental teratogen. Experimental mutagen. May be embryotoxic.

Sodium Nitroferricyanide
CAS No.: 14402-89-2
TSCA CAS Number: 14402-89-2
Percent Range: < 1.0
Percent Range Units: weight / weight
LD50: Oral rat LD_{50} = 99 mg/kg (anhydrous).
LC50: None reported.
TLV: 5 mg/m³ as CN^-
PEL: 5 mg/m³ as CN^-
Hazard: Highly toxic. Harmful if inhaled.

Other components, each
CAS No.: Not applicable
TSCA CAS Number: Not applicable
Percent Range: 0.1 - 1.0
Percent Range Units: weight / weight
LD50: Not applicable
LC50: Not applicable
TLV: Not established
PEL: Not established
Hazard: Any ingredient(s) of this product listed as "Other component(s)" is not considered a health hazard to the user of this product.

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Sodium Citrate
CAS No.: 68-04-2
TSCA CAS Number: 68-04-2
Percent Range: 40.0 - 50.0
Percent Range Units: weight / weight
LD50: Oral rat LD50 >8 g/Kg
LC50: None reported
TLV: Not established
PEL: Not established
Hazard: May cause irritation.

Sodium Tartrate
CAS No.: 6106-24-7
TSCA CAS Number: 868-18-8
Percent Range: 10.0 - 20.0
Percent Range Units: weight / weight
LD50: Oral rabbit LD50 = 5290 mg/kg
LC50: None reported
TLV: Not established
PEL: Not established
Hazard: May cause irritation.

3. HAZARDS IDENTIFICATION

Emergency Overview:
Appearance: Tan powder
Odor: None
HARMFUL IF SWALLOWED, INHALED OR ABSORBED THROUGH SKIN MAY CAUSE EYE, SKIN AND RESPIRATORY TRACT IRRITATION

CONTACT WITH ACIDS FORMS TOXIC FUMES

HMIS:
Health: 3
Flammability: 1
Reactivity: 0
Protective Equipment: X - See protective equipment, Section 8.
NFPA:
Health: 3
Flammability: 1
Reactivity: 0
Symbol: Not applicable
Potential Health Effects:
Eye Contact: May cause irritiation
Skin Contact: May cause irritiation
Skin Absorption: Harmful if absorbed through the skin Effects similar to those of ingestion Sodium nitroferricyanide produces a delayed cyanide poisoning reaction.
Target Organs: Central nervous system Blood
Ingestion: Sodium nitroferricyanide produces a delayed cyanide poisoning reaction. May cause: headache nausea vomiting central nervous system effects
Target Organs: Central nervous system Blood
Inhalation: Sodium nitroferricyanide produces a delayed cyanide poisoning reaction. May cause: headache nausea, vomiting central nervous system effects
Target Organs: Central nervous system Blood
Medical Conditions Aggravated: Allergies or sensitivity to aspirin or salicylates.

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Chronic Effects: Chronic overexposure may cause confusion diarrhea fatigue weakness death Salicylates may cause ringing in the ears (tinnitus), abnormal bleeding, gastric ulceration, mental deterioration, skin eruption, temporary vision loss, and other optical effects.
Cancer / Reproductive Toxicity Information:
This product does NOT contain any OSHA listed carcinogens.

This product does NOT contain any IARC listed chemicals.

This product does NOT contain any NTP listed chemicals.

Additional Cancer / Reproductive Toxicity Information: Contains: an experimental mutagen. an experimental teratogen.
Toxicologically Synergistic Products: None reported

4. FIRST AID

Eye Contact: Immediately flush eyes with water for 15 minutes. Call physician.
Skin Contact (First Aid): Wash skin with soap and plenty of water. Remove contaminated clothing. Call physician immediately.
Ingestion (First Aid): Induce vomiting using syrup of ipecac or by sticking finger down throat. Never give anything by mouth to an unconscious person. Call physician immediately.
Inhalation: Remove to fresh air. Give artificial respiration if necessary. Call physician.

5. FIRE FIGHTING MEASURES

Flammable Properties: During a fire, this product decomposes to form toxic gases.
Flash Point: Not applicable
Method: Not applicable
Flammability Limits:
Lower Explosion Limits: Not applicable
Upper Explosion Limits: Not applicable
Autoignition Temperature: Not determined.
Hazardous Combustion Products: May emit acrid smoke and fumes.
Fire / Explosion Hazards: This product will not burn or explode.
Static Discharge: None reported.
Mechanical Impact: None reported
Extinguishing Media: Dry chemical. Carbon dioxide Alcohol foam.
Fire Fighting Instruction: As in any fire, wear self-contained breathing apparatus pressure-demand and full protective gear. Evacuate area and fight fire from a safe distance.

6. ACCIDENTAL RELEASE MEASURES

Spill Response Notice:
Only persons properly qualified to respond to an emergency involving hazardous substances may respond to a spill according to federal regulations (OSHA 29 CFR 1910.120(a)(v)) and per your company's emergency response plan and guidelines/procedures. See Section 13, Special Instructions for disposal assistance.
Containment Technique: Releases of this material may contaminate the environment. Stop spilled material from being released to the environment.
Clean-up Technique: Avoid contact with spilled material. Sweep up material. Dilute with a large excess of water. Flush the spilled material to the drain with a large excess of water. Decontaminate the area of the spill with a soap solution.
Evacuation Procedure: Evacuate local area (15 foot radius or as directed by your facility's emergency response plan) when: a pound or more of loose powder is spilled. If conditions warrant, increase the size of the evacuation.
Special Instructions (for accidental release): Mixture contains a component which is regulated as hazardous waste.
504 EHS RQ (40 CFR 355): Not applicable
D.O.T. Emergency Response Guide Number: None

7. HANDLING / STORAGE

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Handling: Avoid contact with eyes skin clothing Do not breathe dust. Wash thoroughly after handling. Maintain general industrial hygiene practices when using this product.
Storage: Store between 10° and 25°C. Keep away from: acids / acid fumes, oxidizers
Flammability Class: Not applicable

8. EXPOSURE CONTROLS / PROTECTIVE EQUIPMENT

Engineering Controls: Have an eyewash station nearby. Use a fume hood to avoid exposure to dust, mist or vapor.
Personal Protective Equipment:
Eye Protection: safety glasses with top and side shields
Skin Protection: lab coat disposable latex gloves
Inhalation Protection: laboratory fume hood
Precautionary Measures: eyes skin clothing Do not breathe: dust Wash thoroughly after handling. Use with adequate ventilation. Keep away from: acids/acid fumes oxidizers
TLV: Not established.
PEL: Not established.

9. PHYSICAL / CHEMICAL PROPERTIES

Appearance: Tan powder
Physical State: Solid
Molecular Weight: Not applicable
Odor: None
pH: 7.84 (5% solution)
Vapor Pressure: Not applicable
Vapor Density (air = 1): Not applicable
Boiling Point: Not applicable
Melting Point: 97°C (206.6°F)
Specific Gravity (water = 1): 1.689
Evaporation Rate (water = 1): Not applicable
Volatile Organic Compounds Content: None.
Partition Coefficient (n-octanol / water): Not applicable
Solubility:
Water: Soluble.
Acid: Soluble.
Other: Not determined.
Metal Corrosivity:
Steel: Not applicable
Aluminum: Not applicable

10. STABILITY / REACTIVITY

Chemical Stability: Stable when stored under proper conditions.
Conditions to Avoid: Heating to decomposition. Extreme temperatures
Reactivity / Incompatibility: Incompatible with: acids iodine iron salts lead acetate organic materials oxidizers silver nitrate sodium phosphate
Hazardous Decomposition: Contact with acids/acid fumes releases toxic cyanide gas. Heating to decomposition releases toxic and/or corrosive fumes of: cyanide nitrogen oxides sodium oxides
Hazardous Polymerization: Will not occur.

11. TOXICOLOGICAL INFORMATION

Product Toxicological Data:
LD50: None reported.
LC50: None reported.
Dermal Toxicity Data: None reported.
Skin and Eye Irritation Data: None reported.
Mutation Data: None reported.

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Reproductive Effects Data: None reported.
Ingredient Toxicological Data: Sodium Salicylate: Oral rat LD_{50} = 1200 mg/kg; Sodium Citrate: Oral rat LD_{50} > 8 g/kg; Sodium Tartrate: Oral rabbit LD_{50} = 5290 mg/kg; Sodium Nitroferricyanide: Oral rat LD_{50} = 99 mg/kg.

12. ECOLOGICAL INFORMATION

Product Ecological Information: –
No ecological data available for this product.
Ingredient Ecological Information: --
No ecological data available for the ingredients of this product.

13. DISPOSAL CONSIDERATIONS

EPA Waste ID Number: None
Special Instructions (Disposal): Dilute to 3 to 5 times the volume with cold water. Flush system with plenty of water.
Empty Containers: Rinse three times with an appropriate solvent. Dispose of empty container as normal trash.
NOTICE (Disposal): These disposal guidelines are based on federal regulations and may be superseded by more stringent state or local requirements. Please consult your local environmental regulators for more information.

14. TRANSPORT INFORMATION

D.O.T.:
D.O.T. Proper Shipping Name: Not Currently Regulated
–
DOT Hazard Class: NA
DOT Subsidiary Risk: NA
DOT ID Number: NA
DOT Packing Group: NA
I.C.A.O.:
I.C.A.O. Proper Shipping Name: Not Currently Regulated
–
ICAO Hazard Class: NA
ICAO Subsidiary Risk: NA
ICAO ID Number: NA
ICAO Packing Group: NA
I.M.O.:
I.M.O. Proper Shipping Name: Not Currently Regulated
–
I.M.O. Hazard Class: NA
I.M.O. Subsidiary Risk: NA
I.M.O. ID Number: NA
I.M.O. Packing Group: NA
Additional Information: This product may be shipped as part of a chemical kit composed of various compatible dangerous goods for analytical or testing purposes. This kit would have the following classification: Proper Shipping Name: Chemical Kit Hazard Class: 9 UN Number 3316

15. REGULATORY INFORMATION

U.S. Federal Regulations:
O.S.H.A.: This product meets the criteria for a hazardous substance as defined in the Hazard Communication Standard. (29 CFR 1910.1200)
E.P.A.:
S.A.R.A. Title III Section 311/312 Categorization (40 CFR 370): Immediate (Acute) Health Hazard Delayed (Chronic) Health Hazard
S.A.R.A. Title III Section 313 (40 CFR 372): This product contains a chemical(s) subject to the reporting requirements of Section 313 of Title III of SARA.
Sodium Nitroferricyanide.

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(970) 669-3050

302 (EHS) TPQ (40 CFR 355): Not applicable
304 CERCLA RQ (40 CFR 302.4): Not applicable
304 EHS RQ (40 CFR 355): Not applicable
Clean Water Act (40 CFR 116.4): Not applicable
RCRA: Contains RCRA regulated substances. See Section 13, EPA Waste ID Number.
C.P.S.C.: Not applicable
State Regulations:
California Prop. 65: No Prop. 65 listed chemicals are present in this product.
Identification of Prop. 65 Ingredient(s): Not applicable
Trade Secret Registry: Not applicable
National Inventories:
U.S. Inventory Status: All ingredients in this product are listed on the TSCA 8(b) Inventory (40 CFR 710).
TSCA CAS Number: Not applicable

16. OTHER INFORMATION

Intended Use: Reagent for ammonia test
References: TLV's Threshold Limit Values and Biological Exposure Indices for 1992-1993. American Conference of Governmental Industrial Hygienists, 1992. Technical Judgment. Sixth Annual Report on Carcinogens, 1991. U.S. Department of Health and Human Services. Rockville, MD: Technical Resources, Inc. 1991. Sax, N. Irving. Dangerous Properties of Industrial Materials, 7th Ed. New York: Van Nostrand Reinhold Co., 1989. List of Dangerous Substances Classified in Annex I of the EEC Directive (67/548) - Classification, Packaging and Labeling of Dangerous Substances, Amended July 1992. In-house information. IARC Monographs on the Evaluation of the Carcinogenic Risks to Humans, World Health Organization (Volumes 1-42) Supplement 7. France: 1987. Gosselin, R. E. et al. Clinical Toxicology of Commercial Products, 5th Ed. Baltimore: The Williams and Wilkins Co., 1984. Cassaret and Doull's Toxicology, 3rd Ed. New York: Macmillan Publishing Co., Inc., 1986. Air Contaminants, Federal Register, Vol. 54, No. 12. Thursday, January 19, 1989. pp. 2332-2983. 29 CFR 1900 - 1910 (Code of Federal Regulations - Labor).
Revision Summary: Updates in Section(s) 14.

Legend:

NA - Not Applicable	w/w - weight/weight
ND - Not Determined	w/v - weight/volume
NV - Not Available	v/v - volume/volume

USER RESPONSIBILITY: Each user should read and understand this information and incorporate it in individual site safety programs in accordance with applicable hazard communication standards and regulations.

THE INFORMATION CONTAINED HEREIN IS BASED ON DATA CONSIDERED TO BE ACCURATE. HOWEVER, NO WARRANTY IS EXPRESSED OR IMPLIED REGARDING THE ACCURACY OF THESE DATA OR THE RESULTS TO BE OBTAINED FROM THE USE THEREOF.

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MSDS 4163

Ultimate ACID EATER™

Material Safety Data Sheet

CLIFT INDUSTRIES, INC.
CORPORATE: 800-996-9901
PO BOX 67153
CHARLOTTE, NC 28226

CHEMTREC: 800-424-9300

DATE PREPARED: 11/12/98
DATE REVISED: 11/12/01
DATE OF ORIGINATION: 11/12/98

HAZARD RATING

1= Slight
2= Moderate
3= High
4= Extreme
0= Insignificant

HEALTH	1
FIRE	0
REACTIVITY	0
P.P.E.	D

I. PRODUCT IDENTIFICATION:

Ultimate ACID EATER™

COMMON NAME: CLEANING COMPOUND
GENERIC NAME: CLEANER
CHEMICAL: MIXTURE

II. HAZARDOUS INGREDIENTS:

Ingredients	CAS	%	OSHA PEL ACGIH TLV

No Hazardous Ingredients

III. PHYSICAL/CHEMICAL CHARACTERISTICS:

BOILING POINT:	212	APPEARANCE:	RED
SPECIFIC GRAVITY:	1.1499	FORM:	LIQUID
MELTING POINT:	N/D	ODOR:	AMINE
EVAPORATION RATE:	N/D	VAPOR DENSITY:	N/D
SOLUBILITY (H20, 25C)	SOLUBLE	pH:	10
VOLATIZES CONTENT:	25	VOC (g/L)	N/D

IV. FIRE AND EXPLOSION HAZARD DATA:

FLASH POINT: DEGREES MORE THAN 300°F
LEL: N/D
UEL: N/D

AUTOIGNITION TEMPERATURE: N/D

EXTINGUISHING MEDIA: Product will not support flames. Water may be used to cool fire-exposed containers. Wear self-contained breathing apparatus.

UNUSUAL FIRE/ EXPLOSION HAZARDS: Closed containers exposed to heat may rupture due to pressure.

HAZARDOUS DECOMPOSITION PRODUCTS: NONE KNOWN

V. REACTIVITY:

STABILITY: Stable
CONDITIONS TO AVOID: None known

Ultimate ACID EATER™

Material Safety Data Sheet

VI. HEALTH HAZARDS:

ROUTES AND INDICATIONS OF EXPOSURE

EYES:	May cause irritation to eyes
SKIN:	Good industrial hygiene recommended.
INHALATION:	N/A
INGESTION:	May cause irritation.
TOXICITY DATA:	None as listed by OSHA, NTP, IARC or EPA

EMERGENCY FIRST AID:

EYES:	Flush eyes for fifteen minutes with water. Seek medical attention.
SKIN:	Wash exposed areas with soap and water.
INHALATION:	Remove victim to fresh air or oxygen supply. Administer artificial respiration if victim is unconscious.
INGESTION:	Give victim two glasses of water to dilute ingested material. Do not induce vomiting. If victim begins to vomit involuntarily, keep head below hips to prevent aspiration; monitor for breathing difficulty.

VII. SPILL, DISPOSAL PROCEDURES AND SPECIAL HANDLING:

HANDLING:	Keep closed when not in use. Store at room temperature in well ventilated areas. Prevent product from freezing. Follow MSDS and Label warnings even after package is empty.
IN CASE OF MATERIAL SPILLAGE:	Wear protective equipment (Sec. VIII) Contain, retrieve spilled materials (absorb, vacuum)
WASTE DISPOSAL:	This material is NOT defined as hazardous by the Resource Conservation and Recovery Act. It is the product users responsibility to determine at the time of disposal, whether a material containing the product or derived form the product should be classified as a hazardous waste. (40 FR 261020-40). Spill and releases of this material are not reportable under S.A.R.A. (III) Sec. 313.

VIII. PERSONAL PROTECTIVE EQUIPMENT (P.P.E.)

PROTECTIVE EQUIPMENT:	Wear safety glasses and impervious gloves.
RESPIRATORY PROTECTION:	Supplied-air respiratory protection is recommended for confined spaces. Product should be used only if sufficient ventilation is provided to prevent inhalation of vapors.
ENGINEERING CONTROLS:	Keep containers closed when not in use. Do not handle or store near strong oxidants.
PERSONAL HYGIENE:	Minimize inhalation of vapors. Avoid skin contact. Remove contaminated clothing and wash before reuse. Cleanse skin thoroughly after contact.

IX. REGULATORY INFORMATION:

D.O.T. SHIPPING NAME:	NON-REGULATED
D.O.T. HAZARD CLASSIFICATION:	N/A
S.A.R.A. III Sec. 311 & 312:	N/A
S.A.R.A. III Sec. 313:	Not reportable under S.A.R.A. (III) Sec. 313.
R.C.R.A.:	NO
TSCA Registry:	YES

Close

MATERIAL SAFETY DATA SHEET
Revision Date: 08/24/2004

~~SECTION 1 PRODUCT AND COMPANY IDENTIFICATION~~

Don's Sons

PRODUCT: Shell™ TELLUS OIL 46 ~~562-531-1373~~ 818-786-8180 $6.5
MSDS NUMBER: 402287L - 0
PRODUCT CODE(S): 5061203, 5061244, 5061245, 5061286 14117 Aetna St. Van Nuys CA 91401 per
MANUFACTURER ADDRESS: SOPUS Products, P.O. Box 4427, Houston, TX. 77210-4427

TELEPHONE NUMBERS
Spill Information: (877) 242-7400
Health Information: (877) 504-9351
MSDS Assistance Number: (877) 276-7285

65.25 + T
$ 73.39.

SECTION 2 PRODUCT/INGREDIENTS

CAS#	CONCENTRATION	INGREDIENTS
		Hydraulic Oil
Mixture	90 - 98.99 %weight	Highly refined petroleum oils
Mixture	1 - 4.99 %weight	Additives (contains <1% zinc)

SECTION 3 HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW
Appearance & Odor: Amber, clear liquid. Mild odor.
Health Hazards: No known immediate health hazards. High-pressure injection under the skin may cause serious damage.
Physical Hazards: No known physical hazards.
NFPA Rating (Health, Fire, Reactivity): 0, 1, 0
Hazard Rating: Least - 0 Slight - 1 Moderate - 2 High - 3 Extreme - 4

Inhalation:
Inhalation of vapors (generated at high temperatures only) or oil mist may cause mild irritation of the nose, throat, and respiratory tract.

Eye Irritation:
Lubricating oils are generally considered no more than minimally irritating to the eyes.

Skin Contact:

May cause slight irritation of the skin. If irritation occurs, a temporary burning sensation and minor redness and/or swelling may result. Release of the material during high-pressure applications may result in injection under the skin causing possible extensive tissue damage which is difficult to heal. Other adverse effects not expected from brief skin contact.

Ingestion:
Lubricating oils are generally no more than slightly toxic if swallowed.

Other Health Effects:
Material may release hydrogen sulfide (H_2S), a highly toxic and extremely flammable gas, when heated to 180 Degrees F or higher. H_2S can cause irritation of the eyes and respiratory tract, headache, dizziness, nausea, vomitting, diarrhea, and pulmonary edema. The odor ("rotten egg") threshold is 0.02 ppm. Do not depend on sense of smell for warning; H_2S rapidly deadens the sense of smell.

Signs and Symptoms:
Irritation as noted above. Local necrosis is evidenced by delayed onset of pain and tissue damage a few hours following injection.

Aggravated Medical Conditions:
Pre-existing eye, skin and respiratory disorders may be aggravated by exposure to this product.

For additional health information, refer to section 11.

SECTION 4 FIRST AID MEASURES

Inhalation:
If the victim has difficulty breathing or tightness of the chest, is dizzy, vomiting or unresponsive, give 100% oxygen with rescue breathing or CPR as required and transport to the nearest medical facility.

Skin:
Remove contaminated clothing and shoes and wipe excess from skin. Flush skin with water, then wash with soap and water. If irritation occurs, get medical attention. Do not reuse clothing until cleaned. If material is injected under the skin, transport to the nearest medical facility for additional treatment. If redness, swelling, pain and/or blisters occur, transport to the nearest medical facility for additional treatment.

Eye:
Flush with water. If irritation occurs, get medical attention.

Ingestion:
Do not induce vomiting. In general, no treatment is necessary unless large quantities of product are ingested. However, get medical attention. Have victim rinse mouth out with water, then drink sips of water to remove taste from mouth. If vomiting occurs spontaneously, keep head below hips to prevent aspiration.

Note to Physician:
In general, emesis induction is unnecessary in high viscosity, low volatility

products such as oils and greases.

SECTION 5 FIRE FIGHTING MEASURES

Flash Point [Method]: >375 °F/>190.56 °C [Cleveland Open Cup]

Extinguishing Media:
Material will float and can be re-ignited on surface of water. Use water fog, 'alcohol foam', dry chemical or carbon dioxide (CO2) to extinguish flames. Do not use a direct stream of water.

Fire Fighting Instructions:
Material will not burn unless preheated. Do not enter confined fire space without full bunker gear (helmet with face shield, bunker coats, gloves and rubber boots), including a positive pressure, NIOSH approved, self-contained breathing apparatus.

SECTION 6 ACCIDENTAL RELEASE MEASURES

Protective Measures:
May burn although not readily ignitable.

Wear appropriate personal protective equipment when cleaning up spills. Refer to Section 8.

Spill Management:
FOR LARGE SPILLS: Remove with vacuum truck or pump to storage/salvage vessels.

FOR SMALL SPILLS: Soak up residue with an absorbent such as clay, sand or other suitable material. Place in non-leaking container and seal tightly for proper disposal.

Place in container for proper disposal.

Reporting:
CERCLA: Product is covered by EPA's Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) petroleum exclusion. Releases to air, land, or water are not reportable under CERCLA (Superfund).

CWA: This product is an oil as defined under Section 311 of EPA's Clean Water Act (CWA). Spills into or leading to surface waters that cause a sheen must be reported to the National Response Center, 1-800-424-8802.

SECTION 7 HANDLING AND STORAGE

Precautionary Measures:

Wash with soap and water before eating, drinking, smoking, applying cosmetics, or using toilet. Launder contaminated clothing before reuse. Properly dispose of contaminated leather articles such as shoes or belts that cannot be decontaminated. Avoid heat, open flames, including pilot lights, and strong oxidizing agents. Use explosion-proof ventilation to prevent vapor accumulation. Ground all handling equipment to prevent sparking.

Material may release hydrogen sulfide (H2S), a highly toxic and extremely flammable gas, when heated to 180 Degrees F or higher. H2S may collect in the headspace of the container.

Storage:
Store in a cool, dry place with adequate ventilation. Keep away from open flames and high temperatures.

Container Warnings:
Keep containers closed when not in use. Containers, even those that have been emptied, can contain explosive vapors. Do not cut, drill, grind, weld or perform similar operations on or near containers.

SECTION 8 EXPOSURE CONTROLS/PERSONAL PROTECTION

Oil mist, mineral	ACGIH TLV	TWA: 5 mg/m3	STEL: 10 mg/m2
Oil mist, mineral	OSHA PEL	TWA: 5 mg/m3	
Hydrogen sulfide	ACGIH - TLV	TWA: 10 ppmm	STEL: 15 ppmm
Hydrogen sulfide	OSHA - PEL_IS	TWA: 10 ppmm	STEL: 15 ppmm
Hydrogen sulfide	Thermal	> 180 Degrees F.	

EXPOSURE CONTROLS
Adequate ventilation to control airborne concentrations below the exposure guidelines/limits. Eye washes and showers for emergency use.

PERSONAL PROTECTION
Personal protective equipment (PPE) selections vary based on potential exposure conditions such as handling practices, concentration and ventilation. Information on the selection of eye, skin and respiratory protection for use with this material is provided below.

Eye Protection:
Chemical Goggles - If liquid contact is likely., or Safety glasses with side shields

Skin Protection:
Use protective clothing which is chemically resistant to this material. Selection of protective clothing depends on potential exposure conditions and may include gloves, boots, suits and other items. The selection(s) should take into account such factors as job task, type of exposure and durability requirements.

Published literature, test data and/or glove and clothing manufacturers indicate the best protection is provided by:
Neoprene, or Nitrile Rubber

Respiratory Protection:
If engineering controls do not maintain airborne concentrations to a level which is adequate to protect worker health, an approved respirator must be worn. Respirator selection, use and maintenance should be in accordance with the requirements of the OSHA Respiratory Protection Standard, 29 CFR 1910.134.

Types of respirator(s) to be considered in the selection process include:
For Mist: Air Purifying, R or P style NIOSH approved respirator.
For Vapors: Air Purifying, R or P style prefilter & organic cartridge, NIOSH approved respirator. Self-contained breathing apparatus for use in environments with unknown concentrations or emergency situations.

SECTION 9 PHYSICAL AND CHEMICAL PROPERTIES

Appearance & Odor: Amber, clear liquid. Mild odor.
Substance Chemical Family: Lubricants
Appearance: Amber, clear liquid.

Flash Point: > 375 °F [Cleveland Open Cup]

Pour Point: 10 °F - -20 °F

Specific Gravity: 0.87 - 0.88

Viscosity: > 22 cSt @ 40 °C

SECTION 10 REACTIVITY AND STABILITY

Stability:
Material is stable under normal conditions.

Conditions to Avoid:
Avoid heat and open flames.

Materials to Avoid:
Avoid contact with strong oxidizing agents.

Hazardous Decomposition Products:
Thermal decomposition products are highly dependent on combustion conditions. A complex mixture of airborne solids, liquids and gases will evolve when this material undergoes pyrolysis or combustion. Aldehydes, Carbon Monoxide, Carbon Dioxide, Hydrogen Sulfide, Ketones and other unidentified organic compounds may be formed upon combustion.

SECTION 11 TOXICOLOGICAL INFORMATION

Acute Toxicity
Dermal LD50 >5.0 g/kg(Rabbit) OSHA: Non-Toxic Based on components(s)

Oral LD50 >5.0 g/kg(Rat) OSHA: Non-Toxic Based on components(s)

Carcinogenicity Classification
Hydraulic Oil
NTP: No IARC: Not Reviewed ACGIH: No OSHA: No

SECTION 12 ECOLOGICAL INFORMATION

Environmental Impact Summary:
There is no ecological data available for this product. However, this product is an oil. It is persistent and does not readily biodegrade. However, it does not bioaccumulate.

SECTION 13 DISPOSAL CONSIDERATIONS

RCRA Information:

Under RCRA, it is the responsibility of the user of the material to determine, at the time of the disposal, whether the material meets RCRA criteria for hazardous waste. This is because material uses, transformations, mixtures, processes, etc. may affect the classification. Refer to the latest EPA, state and local regulations regarding proper disposal.

SECTION 14 TRANSPORT INFORMATION

US Department of Transportation Classification
This material is not subject to DOT regulations under 49 CFR Parts 171-180.

Oil: This product is an oil under 49CFR (DOT) Part 130. If shipped by rail or highway in a tank with a capacity of 3500 gallons or more, it is subject to these requirements. Mixtures or solutions containing 10% or more of this product may also be subject to this rule.

International Air Transport Association
Not regulated under IATA rules.

International Maritime Organization Classification
Not regulated under International Maritime Organization rules.

SECTION 15 REGULATORY INFORMATION

FEDERAL REGULATORY STATUS

OSHA Classification:
Product is hazardous according to the OSHA Hazard Communication Standard, 29 CFR 1910.1200, because it carries the occupational exposure limit for mineral oil mist.

Ozone Depleting Substances (40 CFR 82 Clean Air Act):
This material does not contain nor was it directly manufactured with any Class I or Class II ozone depleting substances.

Superfund Amendment & Reauthorization Act (SARA) Title III:

There are no components in this product on the SARA 302 list.

SARA Hazard Categories (311/312):
Immediate Health:NO Delayed Health:NO Fire:NO Pressure:NO
Reactivity:NO

SARA Toxic Release Inventory (TRI) (313):
There are no components in this product on the SARA 313 list.

Toxic Substances Control Act (TSCA) Status:
All component(s) of this material is(are) listed on the EPA/TSCA Inventory of Chemical Substances.

Other Chemical Inventories:
Component(s) of this material is (are) listed on the Australian AICS, Canadian DSL, European EINECS, Korean Inventory,

State Regulation
The following chemicals are specifically listed by individual states; other product specific health and safety data in other sections of the MSDS may also be applicable for state requirements. For details on your regulatory requirements you should contact the appropriate agency in your state.

SECTION 16 OTHER INFORMATION

Revision#: 0
Revision Date: 08/24/2004
Revisions since last change (discussion): This Material Safety Data Sheet (MSDS) has been created to fully comply with the guidance contained in the ANSI MSDS standard (ANSI Z400.1-1998). We encourage you to take the opportunity to read the MSDS and review the information contained therein.

SECTION 17 LABEL INFORMATION

READ AND UNDERSTAND MATERIAL SAFETY DATA SHEET BEFORE HANDLING OR DISPOSING OF PRODUCT. THIS LABEL COMPLIES WITH THE REQUIREMENTS OF THE OSHA HAZARD COMMUNICATION STANDARD (29 CFR 1910.1200) FOR USE IN THE WORKPLACE. THIS LABEL IS NOT INTENDED TO BE USED WITH PACKAGING INTENDED FOR SALE TO CONSUMERS AND MAY NOT CONFORM WITH THE REQUIREMENTS OF THE CONSUMER PRODUCT SAFETY ACT OR

OTHER RELATED REGULATORY REQUIREMENTS.

PRODUCT CODE(S): 5061203, 5061244, 5061245, 5061286

Shell™ TELLUS OIL 46

ATTENTION!

PROLONGED OR REPEATED SKIN CONTACT MAY CAUSE OIL ACNE OR DERMATITIS.
HIGH-PRESSURE INJECTION UNDER SKIN MAY CAUSE SERIOUS DAMAGE.

Precautionary Measures:
Avoid prolonged or repeated contact with eyes, skin and clothing. Avoid breathing of vapors, fumes, or mist. Use only with adequate ventilation. Wash thoroughly after handling.

FIRST AID

Inhalation: If the victim has difficulty breathing or tightness of the chest, is dizzy, vomiting or unresponsive, give 100% oxygen with rescue breathing or CPR as required and transport to the nearest medical facility.
Skin Contact: Remove contaminated clothing and shoes and wipe excess from skin. Flush skin with water, then wash with soap and water. If irritation occurs, get medical attention. Do not reuse clothing until cleaned. If material is injected under the skin, transport to the nearest medical facility for additional treatment. If redness, swelling, pain and/or blisters occur, transport to the nearest medical facility for additional treatment.
Eye Contact: Flush with water. If irritation occurs, get medical attention.
Ingestion: Do not induce vomiting. In general, no treatment is necessary unless large quantities of product are ingested. However, get medical attention. If vomiting occurs spontaneously, keep head below hips to prevent aspiration. Have victim rinse mouth out with water, then drink sips of water to remove taste from mouth.

FIRE

In case of fire, Use water fog, 'alcohol foam', dry chemical or carbon dioxide (CO_2) to extinguish flames. Do not use a direct stream of water. Material will float and can be re-ignited on surface of water.

SPILL OR LEAK

Dike and contain spill.

FOR LARGE SPILLS: Remove with vacuum truck or pump to storage/salvage vessels.

FOR SMALL SPILLS: Soak up residue with an absorbent such as clay, sand or other suitable material. Place in non-leaking container and seal tightly for proper disposal.

CONTAINS: Highly refined petroleum oils, Mixture; Additives (contains <1% zinc), Mixture

NFPA Rating (Health, Fire, Reactivity): 0, 1, 0

TRANSPORTATION

World Headquarters
Hach Company
P.O.Box 389
Loveland, CO USA 80539
(970) 669-3050

MATERIAL SAFETY DATA SHEET

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Name: PhosVer ® 3 Phosphate Reagent
Catalog Number: 2106069

Hach Company
P.O.Box 389
Loveland, CO USA 80539
(970) 669-3050

Emergency Telephone Numbers:
(Medical and Transportation)
(303) 623-5716 24 Hour Service
(515)232-2533 8am - 4pm CST

MSDS Number: M00035
Chemical Name: Not applicable
CAS No.: Not applicable
Chemical Formula: Not applicable
Chemical Family: Not applicable
Hazard: Causes eye burns.
Date of MSDS Preparation:
Day: 23
Month: 09
Year: 2004

2. COMPOSITION / INFORMATION ON INGREDIENTS

Potassium Pyrosulfate
CAS No.: 7790-62-7
TSCA CAS Number: 7790-62-7
Percent Range: 75.0 - 85.0
Percent Range Units: weight / weight
LD50: Oral rat LD50 = 2340 mg/kg
LC50: None reported
TLV: Not established
PEL: Not established
Hazard: Causes eye burns.

Ascorbic Acid
CAS No.: 50-81-7
TSCA CAS Number: 50-81-7
Percent Range: 15.0 - 25.0
Percent Range Units: weight / weight
LD50: Oral rat LD50 = 11900 mg/kg
LC50: None reported
TLV: Not established
PEL: Not established
Hazard: Practically non-toxic.

Sodium Molybdate
CAS No.: 10102-40-6
TSCA CAS Number: 7631-95-0
Percent Range: 1.0 - 10.0
Percent Range Units: weight / weight
LD50: Oral rat LD_{50} = 4000 mg/kg.
LC50: Inhalation rat LC50 = > 2080 mg/m³/4 hrs
TLV: 5 mg/m³ (as Mo)
PEL: 5 mg/m³ (as Mo)
Hazard: May cause irritation.

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(970) 669-3050

Skin Contact (First Aid): Wash skin with plenty of water.
Ingestion (First Aid): Do not induce vomiting. Give 1-2 glasses of water. Call physician immediately. Never give anything by mouth to an unconscious person.
Inhalation: Remove to fresh air. Give artificial respiration if necessary. Call physician.

5. FIRE FIGHTING MEASURES

Flammable Properties: Can burn in fire, releasing toxic vapors.
Flash Point: Not applicable
Method: Not applicable
Flammability Limits:
Lower Explosion Limits: Not applicable
Upper Explosion Limits: Not applicable
Autoignition Temperature: Not determined
Hazardous Combustion Products: Toxic fumes of: sulfur oxides, carbon monoxide, carbon dioxide, sodium monoxide
Fire / Explosion Hazards: None reported
Static Discharge: None reported.
Mechanical Impact: None reported
Extinguishing Media: Use media appropriate to surrounding fire conditions
Fire Fighting Instruction: As in any fire, wear self-contained breathing apparatus pressure-demand and full protective gear.

6. ACCIDENTAL RELEASE MEASURES

Spill Response Notice:
Only persons properly qualified to respond to an emergency involving hazardous substances may respond to a spill according to federal regulations (OSHA 29 CFR 1910.120(a)(v)) and per your company's emergency response plan and guidelines/procedures. See Section 13, Special Instructions for disposal assistance.
Containment Technique: Stop spilled material from being released to the environment.
Clean-up Technique: Scoop up spilled material into a large beaker and dissolve with water. Adjust to a pH between 6 and 9 with an alkali, such as soda ash or sodium bicarbonate. Flush reacted material to the drain with a large excess of water. Decontaminate the area of the spill with a soap solution.
Evacuation Procedure: Evacuate local area (15 foot radius or as directed by your facility's emergency response plan) when: any quantity is spilled.
Special Instructions (for accidental release): Not applicable
304 EHS RQ (40 CFR 355): Not applicable
D.O.T. Emergency Response Guide Number: None

7. HANDLING / STORAGE

Handling: Avoid contact with eyes Do not breathe dust. Wash thoroughly after handling. Maintain general industrial hygiene practices when using this product.
Storage: Store between 10° and 25°C.
Flammability Class: Not applicable

8. EXPOSURE CONTROLS / PROTECTIVE EQUIPMENT

Engineering Controls: Have an eyewash station nearby. Maintain general industrial hygiene practices when using this product.
Personal Protective Equipment:
Eye Protection: safety glasses with top and side shields
Skin Protection: disposable latex gloves lab coat
Inhalation Protection: adequate ventilation
Precautionary Measures: Avoid contact with: eyes Do not breathe: dust Wash thoroughly after handling.
TLV: Not established
PEL: Not established

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Empty Containers: Rinse three times with an appropriate solvent. Dispose of empty container as normal trash.
NOTICE (Disposal): These disposal guidelines are based on federal regulations and may be superseded by more stringent state or local requirements. Please consult your local environmental regulators for more information.

14. TRANSPORT INFORMATION

D.O.T.:
D.O.T. Proper Shipping Name: Not Currently Regulated
—
DOT Hazard Class: NA
DOT Subsidiary Risk: NA
DOT ID Number: NA
DOT Packing Group: NA
I.C.A.O.:
I.C.A.O. Proper Shipping Name: Not Currently Regulated
—
ICAO Hazard Class: NA
ICAO Subsidiary Risk: NA
ICAO ID Number: NA
ICAO Packing Group: NA
I.M.O.:
I.M.O. Proper Shipping Name: Not Currently Regulated
—
I.M.O. Hazard Class: NA
I.M.O. Subsidiary Risk: NA
I.M.O. ID Number: NA
I.M.O. Packing Group: NA
Additional Information: This product may be shipped as part of a chemical kit composed of various compatible dangerous goods for analytical or testing purposes. This kit would have the following classification: Proper Shipping Name: Chemical Kit Hazard Class: 9 UN Number 3316

15. REGULATORY INFORMATION

U.S. Federal Regulations:
O.S.H.A.: This product meets the criteria for a hazardous substance as defined in the Hazard Communication Standard. (29 CFR 1910.1200)
E.P.A.:
S.A.R.A. Title III Section 311/312 Categorization (40 CFR 370): Immediate (Acute) Health Hazard Delayed (Chronic) Health Hazard
S.A.R.A. Title III Section 313 (40 CFR 372): This product does NOT contain any chemical subject to the reporting requirements of Section 313 of Title III of SARA.
—
302 (EHS) TPQ (40 CFR 355): Not applicable
304 CERCLA RQ (40 CFR 302.4): Not applicable
304 EHS RQ (40 CFR 355): Not applicable
Clean Water Act (40 CFR 116.4): Not applicable
RCRA: Contains no RCRA regulated substances.
C.P.S.C.: Not applicable
State Regulations:
California Prop. 65: No Prop. 65 listed chemicals are present in this product.
Identification of Prop. 65 Ingredient(s): Not applicable
Trade Secret Registry: Not applicable
National Inventories:
U.S. Inventory Status: All ingredients in this product are listed on the TSCA 8(b) Inventory (40 CFR 710).
TSCA CAS Number: Not applicable

16. OTHER INFORMATION

World Headquarters
Hach Company
P.O. Box 389
Loveland, CO USA 80539
(970) 669-3050

MATERIAL SAFETY DATA SHEET

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Name: NitraVer ® 5 Nitrate Reagent
Catalog Number: 2106169

Hach Company
P.O.Box 389
Loveland, CO USA 80539
(970) 669-3050

Emergency Telephone Numbers:
(Medical and Transportation)
(303) 623-5716 24 Hour Service
(515)232-2533 8am - 4pm CST

MSDS Number: M00049
Chemical Name: Not applicable
CAS No.: Not applicable
Chemical Formula: Not applicable
Chemical Family: Not applicable
Hazard: Toxic. Cumulative poison. Recognized carcinogen. Experimental teratogen. May cause irritation.
Date of MSDS Preparation:
Day: 23
Month: 03
Year: 2005

2. COMPOSITION / INFORMATION ON INGREDIENTS

Potassium Phosphate, Monobasic
CAS No.: 7778-77-0
TSCA CAS Number: 7778-77-0
Percent Range: 30.0 - 40.0
Percent Range Units: weight / weight
LD50: Oral rat LD50 = 7100 mg/kg
LC50: None reported
TLV: Not established
PEL: Not established
Hazard: May cause irritation.

Other components, each
CAS No.: Not applicable
TSCA CAS Number: Not applicable
Percent Range: < 1.0
Percent Range Units: weight / weight
LD50: Not applicable
LC50: Not applicable
TLV: Not established
PEL: Not established
Hazard: Any ingredient(s) of this product listed as "Other component(s)" is not considered a health hazard to the user of this product.

Magnesium Sulfate
CAS No.: 10034-99-8
TSCA CAS Number: 7487-88-9
Percent Range: 5.0 - 15.0
Percent Range Units: weight / weight
LD50: Oral mouse LD$_{Lo}$ 5000 mg/kg
LC50: None reported
TLV: Not established
PEL: Not established
Hazard: May cause irritation.

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Ingestion: May cause: salivation vomiting abdominal pain anemia diarrhea kidney failure central nervous system effects cardiac depression
Target Organs: Kidneys Reproductive system Central nervous system
Inhalation: May cause: coughing headache nausea, vomiting chest pain pneumonitis respiratory tract irritation lung damage kidney damage
Target Organs: Kidneys Reproductive system Lungs
Medical Conditions Aggravated: Pre-existing: Respiratory conditions Kidney conditions Liver conditions
Chronic Effects: Chronic overexposure may cause cancer liver damage kidney damage bone damage (osteosclerosis)
Cancer / Reproductive Toxicity Information:
An ingredient of this product is an OSHA listed carcinogen.
Cadmium
An ingredient of this mixture is: IARC Group 1: Recognized Carcinogen
Cadmium
An ingredient of this mixture is: NTP Listed Group 1: Recognized Carcinogen
Cadmium
Additional Cancer / Reproductive Toxicity Information: Contains: an ACGIH A2 suspected human carcinogen.
Toxicologically Synergistic Products: None reported

4. FIRST AID

Eye Contact: Immediately flush eyes with water for 15 minutes. Call physician.
Skin Contact (First Aid): Wash skin with soap and plenty of water. Call physician if irritation develops.
Ingestion (First Aid): Administer milk or beaten egg whites at frequent intervals. Induce vomiting using syrup of ipecac or by sticking finger down throat. Never give anything by mouth to an unconscious person. Call physician immediately.
Inhalation: Remove to fresh air. Give artificial respiration if necessary. Call physician.

5. FIRE FIGHTING MEASURES

Flammable Properties: Can burn in fire, releasing toxic vapors.
Flash Point: Not applicable
Method: Not applicable
Flammability Limits:
Lower Explosion Limits: Not applicable
Upper Explosion Limits: Not applicable
Autoignition Temperature: Not available
Hazardous Combustion Products: Toxic fumes of: cadmium oxide nitrogen oxides, sulfur oxides, phosphorus oxides
Fire / Explosion Hazards: May react violently with: strong oxidizers hydrazoic acid ammonium nitrate
Static Discharge: None reported.
Mechanical Impact: None reported
Extinguishing Media: Water. Carbon dioxide Dry chemical.
Fire Fighting Instruction: As in any fire, wear self-contained breathing apparatus pressure-demand and full protective gear.

6. ACCIDENTAL RELEASE MEASURES

Spill Response Notice:
Only persons properly qualified to respond to an emergency involving hazardous substances may respond to a spill according to federal regulations (OSHA 29 CFR 1910.120(a)(v)) and per your company's emergency response plan and guidelines/procedures. See Section 13, Special Instructions for disposal assistance.
Containment Technique: Releases of this material may contaminate the environment. Stop spilled material from being released to the environment.
Clean-up Technique: Avoid breathing spilled material. Avoid contact with spilled material. Sweep up material. Dispose of material in an E.P.A. approved hazardous waste facility. Decontaminate the area of the spill with a soap solution.
Evacuation Procedure: Evacuate general area (50 foot radius or as directed by your facility's emergency response plan) when: any quantity is spilled. If conditions warrant, increase the size of the evacuation.
Special Instructions (for accidental release): Product is regulated as RCRA hazardous waste.
304 EHS RQ (40 CFR 355): Not applicable
D.O.T. Emergency Response Guide Number: None

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LC50: None reported
Dermal Toxicity Data: None reported
Skin and Eye Irritation Data: Sulfanilic acid: Skin rabbit 500 mg/24H - Standard Draize - MILD; Eye rabbit 100 mg/24H - Standard Draize - MODERATE
Mutation Data: Cadmium - Cytogenetic analysis - hamster ovary 1 µmol/l
Reproductive Effects Data: Cadmium: Oral male rat TDLo = 155 mg/kg - 13 weeks pre-mating - effects on newborn growth and behavior; Oral female rat TDLo = 23 mg/kg - 1-22 days after conception - blood and lymphatic system abnormalities
Ingredient Toxicological Data: Cadmium: Oral rat LD50 = 225 mg/kg, Inhalation rat LC50 = 25 mg/m^3/30 min; Gentisic acid Oral rat LD50 = 800 mg/kg; Sulfanilic acid Oral rat LD50 = 12.3 g/kg; KH_2PO_4 Oral rat LD50 = 7100 mg/kg

12. ECOLOGICAL INFORMATION

Product Ecological Information: --
No ecological data available for this product.
Ingredient Ecological Information: --
No ecological data available for the ingredients of this product.

13. DISPOSAL CONSIDERATIONS

EPA Waste ID Number: D006
Special Instructions (Disposal): Dispose of material in an E.P.A. approved hazardous waste facility.
Empty Containers: Rinse three times with an appropriate solvent. Rinsate from empty containers may contain sufficient product to require disposal as hazardous waste. Dispose of empty container as normal trash.
NOTICE (Disposal): These disposal guidelines are based on federal regulations and may be superseded by more stringent state or local requirements. Please consult your local environmental regulators for more information.

14. TRANSPORT INFORMATION

D.O.T.:
D.O.T. Proper Shipping Name: Not Currently Regulated
--
DOT Hazard Class: NA
DOT Subsidiary Risk: NA
DOT ID Number: NA
DOT Packing Group: NA
I.C.A.O.:
I.C.A.O. Proper Shipping Name: Not Currently Regulated
--
ICAO Hazard Class: NA
ICAO Subsidiary Risk: NA
ICAO ID Number: NA
ICAO Packing Group: NA
I.M.O.:
I.M.O. Proper Shipping Name: Not Currently Regulated
--
I.M.O. Hazard Class: NA
I.M.O. Subsidiary Risk: NA
I.M.O. ID Number: NA
I.M.O. Packing Group: NA
Additional Information: This product may be shipped as part of a chemical kit composed of various compatible dangerous goods for analytical or testing purposes. This kit would have the following classification: Proper Shipping Name: Chemical Kit Hazard Class: 9 UN Number 3316

15. REGULATORY INFORMATION

U.S. Federal Regulations:

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Hach Company
P.O.Box 389
Loveland, CO USA 80539
(970) 669-3050

MATERIAL SAFETY DATA SHEET

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Name: Sulfide 1 Reagent
Catalog Number: 181632

Hach Company
P.O.Box 389
Loveland, CO USA 80539
(970) 669-3050

Emergency Telephone Numbers:
(Medical and Transportation)
(303) 623-5716 24 Hour Service
(515)232-2533 8am - 4pm CST

MSDS Number: M00213
Chemical Name: Not applicable
CAS No.: Not applicable
Chemical Formula: Not applicable
Chemical Family: Not applicable
Hazard: Harmful if inhaled. Causes severe burns. Carcinogen.
Date of MSDS Preparation:
Day: 22
Month: 09
Year: 2004

2. COMPOSITION / INFORMATION ON INGREDIENTS

Demineralized Water
CAS No.: 7732-18-5
TSCA CAS Number: 7732-18-5
Percent Range: 35.0 - 45.0
Percent Range Units: weight / weight
LD50: None reported
LC50: None reported
TLV: Not established
PEL: Not established
Hazard: No effects anticipated.

Other component
CAS No.: Not applicable
TSCA CAS Number: Not applicable
Percent Range: 0.1 - 1.0
Percent Range Units: weight / weight
LD50: Not applicable
LC50: Not applicable
TLV: Not established
PEL: Not established
Hazard: Any ingredient(s) of this product listed as "Other component(s)" is not considered a health hazard to the user of this product.

Sulfuric Acid
CAS No.: 7664-93-9
TSCA CAS Number: 7664-93-9
Percent Range: 55.0 - 65.0
Percent Range Units: weight / weight
LD50: Oral rat LD50 = 2140 mg/kg.
LC50: Inhalation rat LC50 = 87 ppm/4 hr
TLV: 1 mg/m^3 (TWA); 3 mg/m^3 (STEL)
PEL: 1 mg/m^3
Hazard: Causes severe burns. Harmful if inhaled. Recognized carcinogen.

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Flash Point: Not applicable
Method: Not applicable
Flammability Limits:
Lower Explosion Limits: Not applicable
Upper Explosion Limits: Not applicable
Autoignition Temperature: Not applicable
Hazardous Combustion Products: This material will not burn. May emit acrid smoke and fumes.
Fire / Explosion Hazards: Contact with metals gives off hydrogen gas which is flammable May react violently with: strong bases water
Static Discharge: None reported.
Mechanical Impact: None reported
Extinguishing Media: Dry chemical. Do NOT use water.
Fire Fighting Instruction: As in any fire, wear self-contained breathing apparatus pressure-demand and full protective gear.

6. ACCIDENTAL RELEASE MEASURES

Spill Response Notice:
Only persons properly qualified to respond to an emergency involving hazardous substances may respond to a spill according to federal regulations (OSHA 29 CFR 1910.120(a)(v)) and per your company's emergency response plan and guidelines/procedures. See Section 13, Special Instructions for disposal assistance.
Containment Technique: Absorb spilled liquid with non-reactive sorbent material. Stop spilled material from being released to the environment. Dike large spills to keep spilled material from entering sewage and drainage systems or bodies of water.
Clean-up Technique: Remove all combustible materials from the spill area. Absorb spilled liquid with non-reactive sorbent material. Work in an approved fume hood. Working in small batches, dilute with excess water. Adjust to a pH between 6 and 9 with an alkali, such as soda ash or sodium bicarbonate. Filter to remove solids. Flush reacted material to the drain with a large excess of water. Decontaminate the area of the spill with a soap solution.
Evacuation Procedure: Evacuate local area (15 foot radius or as directed by your facility's emergency response plan) when: any quantity is spilled. If conditions warrant, increase the size of the evacuation.
Special Instructions (for accidental release): Mixture contains a component which is regulated as a water pollutant. Mixture contains a component which is regulated as hazardous waste.
304 EHS RQ (40 CFR 355): Sulfuric Acid - RQ 1000 lbs.
D.O.T. Emergency Response Guide Number: 137

7. HANDLING / STORAGE

Handling: Avoid contact with eyes skin clothing Do not breathe mist or vapors. Wash thoroughly after handling. Use with adequate ventilation. Maintain general industrial hygiene practices when using this product.
Storage: Store between 10° and 25°C. Keep container tightly closed when not in use. Keep away from: alkalies oxidizers reducers metals
Flammability Class: Not applicable

8. EXPOSURE CONTROLS / PROTECTIVE EQUIPMENT

Engineering Controls: Have an eyewash station nearby. Have a safety shower nearby. Use general ventilation to minimize exposure to mist, vapor or dust. Maintain general industrial hygiene practices when using this product.
Personal Protective Equipment:
Eye Protection: safety glasses with top and side shields
Skin Protection: disposable latex gloves lab coat
Inhalation Protection: adequate ventilation
Precautionary Measures: Avoid contact with: eyes skin clothing Do not breathe: mist/vapor Wash thoroughly after handling. Use with adequate ventilation. Keep away from: alkalies metals oxidizers reducers
TLV: Not established
PEL: Not established

9. PHYSICAL / CHEMICAL PROPERTIES

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NOTICE (Disposal): These disposal guidelines are based on federal regulations and may be superseded by more stringent state or local requirements. Please consult your local environmental regulators for more information.

14. TRANSPORT INFORMATION

D.O.T.:
D.O.T. Proper Shipping Name: Sulphuric Acid Solution
--
DOT Hazard Class: 8
DOT Subsidiary Risk: NA
DOT ID Number: UN1830
DOT Packing Group: II
I.C.A.O.:
I.C.A.O. Proper Shipping Name: Sulphuric Acid Solution
--
ICAO Hazard Class: 8
ICAO Subsidiary Risk: NA
ICAO ID Number: UN1830
ICAO Packing Group: II
I.M.O.:
I.M.O. Proper Shipping Name: Sulphuric Acid Solution
--
I.M.O. Hazard Class: 8
I.M.O. Subsidiary Risk: NA
I.M.O. ID Number: UN1830
I.M.O. Packing Group: II
Additional Information: This product may be shipped as part of a chemical kit composed of various compatible dangerous goods for analytical or testing purposes. This kit would have the following classification: Proper Shipping Name: Chemical Kit Hazard Class: 9 UN Number 3316

15. REGULATORY INFORMATION

U.S. Federal Regulations:
O.S.H.A.: This product meets the criteria for a hazardous substance as defined in the Hazard Communication Standard. (29 CFR 1910.1200)
E.P.A.:
S.A.R.A. Title III Section 311/312 Categorization (40 CFR 370): Reactive Immediate (Acute) Health Hazard Delayed (Chronic) Health Hazard
S.A.R.A. Title III Section 313 (40 CFR 372): This product contains a chemical(s) subject to the reporting requirements of Section 313 of Title III of SARA.
Sulfuric acid
302 (EHS) TPQ (40 CFR 355): 1000 lbs. Sulfuric Acid
304 CERCLA RQ (40 CFR 302.4): 1000 lbs. Sulfuric Acid
304 EHS RQ (40 CFR 355): Sulfuric Acid - RQ 1000 lbs.
Clean Water Act (40 CFR 116.4): Sulfuric acid - RQ 1000 lbs.
RCRA: Contains RCRA regulated substances. See Section 13, EPA Waste ID Number.
C.P.S.C.: The label for this product bears the signal word "POISON" because the concentration of Sulfuric Acid in the product is greater than/equal to 10%.
State Regulations:
California Prop. 65: No Prop. 65 listed chemicals are present in this product.
Identification of Prop. 65 Ingredient(s): Not applicable
Trade Secret Registry: Not applicable
National Inventories:
U.S. Inventory Status: All ingredients in this product are listed on the TSCA 8(b) Inventory (40 CFR 710).
TSCA CAS Number: Not applicable

16. OTHER INFORMATION

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Hach Company
P.O.Box 389
Loveland, CO USA 80539
(970) 669-3050

MATERIAL SAFETY DATA SHEET

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Name: Sulfide 2 Reagent
Catalog Number: 181732

Hach Company
P.O.Box 389
Loveland, CO USA 80539
(970) 669-3050

Emergency Telephone Numbers:
(Medical and Transportation)
(303) 623-5716 24 Hour Service
(515)232-2533 8am - 4pm CST

MSDS Number: M00435
Chemical Name: Not applicable
CAS No.: Not applicable
Chemical Formula: Not applicable
Chemical Family: Not applicable
Hazard: Carcinogen. Experimental mutagen. Experimental teratogen. May cause allergic reaction.
Date of MSDS Preparation:
Day: 03
Month: December
Year: 2001

2. COMPOSITION / INFORMATION ON INGREDIENTS

Demineralized Water
CAS No.: 7732-18-5
TSCA CAS Number: 7732-18-5
Percent Range: > 99.0
Percent Range Units: weight / weight
LD50: None reported
LC50: None reported
TLV: Not established
PEL: Not established
Hazard: No effects anticipated.

Potassium Dichromate
CAS No.: 7778-50-9
TSCA CAS Number: 7778-50-9
Percent Range: 0.1 - 1.0
Percent Range Units: weight / weight
LD50: Oral mouse LD_{50} = 190 mg/kg; Oral human (child) LDLo = 26 mg/kg.
LC50: None reported.
TLV: 0.05 mg Cr^6/m^3 Water-soluble; 0.01 mg Cr^6/m^3 Insoluble compounds
PEL: 0.5 mg/m³ (Cr^{+6}), Ceiling; Proposed PEL: 1 µg Cr^6/m^3, TWA (Oct 4 FR Pg 59307).
Hazard: Toxic. Causes burns. May cause allergic reaction. Carcinogen. Experimental mutagen. Experimental teratogen. Oxidizer.

3. HAZARDS IDENTIFICATION

Emergency Overview:
Appearance: Clear, orange
Odor: None

MAY CAUSE ALLERGIC SKIN REACTION CANCER HAZARD CONTAINS MATERIAL WHICH CAN CAUSE CANCER

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Fire Fighting Instruction: As in any fire, wear self-contained breathing apparatus pressure-demand and full protective gear. Evacuate area and fight fire from a safe distance. Water runoff can cause environmental damage. Dike and collect water used to fight fire.

6. ACCIDENTAL RELEASE MEASURES

Spill Response Notice:
Only persons properly qualified to respond to an emergency involving hazardous substances may respond to a spill according to federal regulations (OSHA 29 CFR 1910.120(a)(v)) and per your company's emergency response plan and guidelines/procedures. See Section 13, Special Instructions for disposal assistance.
Containment Technique: Releases of this material may contaminate the environment. Stop spilled material from being released to the environment.
Clean-up Technique: Cover spilled material with an alkali, such as soda ash or sodium bicarbonate. Scoop up slurry into a large beaker. Adjust to a pH between 6 and 9 with an alkali, such as soda ash or sodium bicarbonate. Dispose of material in an E.P.A. approved hazardous waste facility. Decontaminate the area of the spill with a soap solution.
Evacuation Procedure: Evacuate as needed to perform spill clean-up. If conditions warrant, increase the size of the evacuation.
Special Instructions (for accidental release): Mixture contains a component which is regulated as hazardous waste. Mixture contains a component which is regulated as a hazardous air pollutant. Mixture contains a component which is regulated as a water pollutant.
304 EHS RQ (40 CFR 355): Not applicable
D.O.T. Emergency Response Guide Number: Not applicable

7. HANDLING / STORAGE

Handling: Avoid contact with eyes skin Do not breathe mist or vapors. Wash thoroughly after handling. Maintain general industrial hygiene practices when using this product.
Storage: Keep container tightly closed when not in use. Store in a cool, dry place. Protect from: light
Flammability Class: Not applicable

8. EXPOSURE CONTROLS / PROTECTIVE EQUIPMENT

Engineering Controls: Maintain general industrial hygiene practices when using this product.
Personal Protective Equipment:
Eye Protection: safety glasses with top and side shields
Skin Protection: disposable latex gloves lab coat
Inhalation Protection: adequate ventilation
Precautionary Measures: Avoid contact with: eyes skin Do not breathe: mist/vapor Wash thoroughly after handling. Use with adequate ventilation.
TLV: Not established.
PEL: Not established.

9. PHYSICAL / CHEMICAL PROPERTIES

Appearance: Clear, orange
Physical State: Liquid
Molecular Weight: Not applicable
Odor: None
pH: 4.2
Vapor Pressure: Not determined.
Vapor Density (air = 1): Not determined.
Boiling Point: ~ 100°C (~212°F)
Melting Point: Not applicable
Specific Gravity (water = 1): 0.987
Evaporation Rate (water = 1): Not determined.
Volatile Organic Compounds Content: None.
Partition Coefficient (n-octanol / water): Not applicable
Solubility:

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ICAO Subsidiary Risk: NA
ICAO ID Number: NA
ICAO Packing Group: NA
I.M.O.:
I.M.O. Proper Shipping Name: Not Currently Regulated
I.M.O. Hazard Class: NA
I.M.O. Subsidiary Risk: NA
I.M.O. ID Number: NA
I.M.O. Packing Group: NA
Additional Information: This product may be shipped as part of a chemical kit composed of various compatible dangerous goods for analytical or testing purposes. This kit would have the following classification: Proper Shipping Name: Chemical Kit Hazard Class: 9 UN Number 3316

15. REGULATORY INFORMATION

U.S. Federal Regulations:
O.S.H.A.: This product meets the criteria for a hazardous substance as defined in the Hazard Communication Standard. (29 CFR 1910.1200)
E.P.A.:
S.A.R.A. Title III Section 311/312 Categorization (40 CFR 370): Delayed (Chronic) Health Hazard Fire Hazard
S.A.R.A. Title III Section 313 (40 CFR 372): This product contains a chemical(s) subject to the reporting requirements of Section 313 of Title III of SARA.
Chromium Compounds.
302 (EHS) TPQ (40 CFR 355): Not applicable
304 CERCLA RQ (40 CFR 302.4): Potassium bichromate: 10 lbs.
304 EHS RQ (40 CFR 355): Not applicable
Clean Water Act (40 CFR 116.4): Potassium bichromate - RQ = 10 lbs. (4.54 kgs.)
RCRA: Contains RCRA regulated substances. See Section 13, EPA Waste ID Number.
C.P.S.C.: Not applicable
State Regulations:
California Prop. 65: WARNING - This product contains a chemical known to the State of California to cause cancer.
Identification of Prop. 65 Ingredient(s): Chromium (hexavalent compounds)
Trade Secret Registry: Not applicable
National Inventories:
U.S. Inventory Status: All ingredients in this product are listed on the TSCA 8(b) Inventory (40 CFR 710).
TSCA CAS Number: Not applicable

16. OTHER INFORMATION

Intended Use: Determination of sulfides
References: 29 CFR 1900 - 1910 (Code of Federal Regulations - Labor). Air Contaminants, Federal Register, Vol. 54, No. 12. Thursday, January 19, 1989. pp. 2332-2983. CCINFO RTECS. Canadian Centre for Occupational Health and Safety. Hamilton, Ontario Canada: 30 June 1993. Gosselin, R. E. et al. Clinical Toxicology of Commercial Products, 5th Ed. Baltimore: The Williams and Wilkins Co., 1984. IARC Monographs on the Evaluation of the Carcinogenic Risks to Humans. World Health Organization (Volumes 1-42) Supplement 7. France: 1987. List of Dangerous Substances Classified in Annex I of the EEC Directive (67/548) - Classification, Packaging and Labeling of Dangerous Substances, Amended July 1992. Sixth Annual Report on Carcinogens, 1991. U.S. Department of Health and Human Services. Rockville, MD: Technical Resources, Inc. 1991. Technical Judgment. The Merck Index, 11th Ed. Rahway, New Jersey: Merck and Co., Inc., 1989. TLV's Threshold Limit Values and Biological Exposure Indices for 1992-1993. American Conference of Governmental Industrial Hygienists, 1992. Vendor Information.
Revision Summary: Updates in Section(s) 14,

Legend:

NA - Not Applicable	w/w - weight/weight
ND - Not Determined	w/v - weight/volume

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Hach Company
P.O.Box 389
Loveland, CO USA 80539
(970) 669-3050

MATERIAL SAFETY DATA SHEET

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Name: NitriVer ® 3 Nitrite Reagent
Catalog Number: 2107169

Hach Company
P.O.Box 389
Loveland, CO USA 80539
(970) 669-3050

Emergency Telephone Numbers:
(Medical and Transportation)
(303) 623-5716 24 Hour Service
(515)232-2533 8am - 4pm CST

MSDS Number: M00055
Chemical Name: Not applicable
CAS No.: Not applicable
Chemical Formula: Not applicable
Chemical Family: Not applicable
Hazard: Causes eye burns.
Date of MSDS Preparation:
Day: 23
Month: 09
Year: 2004

2. COMPOSITION / INFORMATION ON INGREDIENTS

Chromatropic Acid, Disodium salt
CAS No.: 129-96-4
TSCA CAS Number: 129-96-4
Percent Range: 1.0 - 5.0
Percent Range Units: weight / weight
LD50: Oral rat LD50 > 5000 mg/kg
LC50: None reported
TLV: Not established
PEL: Not established
Hazard: May cause irritation.

Sodium Sulfanilate
CAS No.: 515-74-2
TSCA CAS Number: 515-74-2
Percent Range: 5.0 - 15.0
Percent Range Units: weight / weight
LD50: None reported
LC50: None reported
TLV: Not established
PEL: Not established
Hazard: Toxic properties unknown. May cause irritation.

Potassium Pyrosulfate
CAS No.: 7790-62-7
TSCA CAS Number: 7790-62-7
Percent Range: 1.0 - 10.0
Percent Range Units: weight / weight
LD50: Oral rat LD50 = 2340 mg/kg
LC50: None reported
TLV: Not established
PEL: Not established
Hazard: Causes eye burns.

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This product does NOT contain any NTP listed chemicals.

Additional Cancer / Reproductive Toxicity Information: None reported
Toxicologically Synergistic Products: None reported

4. FIRST AID

Eye Contact: Immediately flush eyes with water for 15 minutes. Call physician.
Skin Contact (First Aid): Wash skin with soap and plenty of water. Call physician if irritation develops.
Ingestion (First Aid): Do not induce vomiting. Give 1-2 glasses of water. Call physician immediately. Never give anything by mouth to an unconscious person.
Inhalation: Remove to fresh air. Give artificial respiration if necessary. Call physician.

5. FIRE FIGHTING MEASURES

Flammable Properties: During a fire, this product decomposes to form toxic gases.
Flash Point: Not applicable
Method: Not applicable
Flammability Limits:
Lower Explosion Limits: Not applicable
Upper Explosion Limits: Not applicable
Autoignition Temperature: Not applicable
Hazardous Combustion Products: Toxic fumes of: phosphorus oxides carbon monoxide, carbon dioxide.
Fire / Explosion Hazards: None reported
Static Discharge: None reported.
Mechanical Impact: None reported
Extinguishing Media: Use media appropriate to surrounding fire conditions
Fire Fighting Instruction: As in any fire, wear self-contained breathing apparatus pressure-demand and full protective gear.

6. ACCIDENTAL RELEASE MEASURES

Spill Response Notice:
Only persons properly qualified to respond to an emergency involving hazardous substances may respond to a spill according to federal regulations (OSHA 29 CFR 1910.120(a)(v)) and per your company's emergency response plan and guidelines/procedures. See Section 13, Special Instructions for disposal assistance.
Containment Technique: Stop spilled material from being released to the environment.
Clean-up Technique: Scoop up spilled material into a large beaker and dissolve with water. Adjust to a pH between 6 and 9 with an alkali, such as soda ash or sodium bicarbonate. Flush the spilled material to the drain with a large excess of water.
Evacuation Procedure: Evacuate local area (15 foot radius or as directed by your facility's emergency response plan) when: any quantity is spilled.
Special Instructions (for accidental release): Not applicable
304 EHS RQ (40 CFR 355): Not applicable
D.O.T. Emergency Response Guide Number: None

7. HANDLING / STORAGE

Handling: Avoid contact with eyes skin Do not breathe dust. Wash thoroughly after handling. Maintain general industrial hygiene practices when using this product.
Storage: Protect from: light heat moisture
Flammability Class: Not applicable

8. EXPOSURE CONTROLS / PROTECTIVE EQUIPMENT

Engineering Controls: Have an eyewash station nearby. Maintain general industrial hygiene practices when using this product.

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No ecological data available for the ingredients of this product.

13. DISPOSAL CONSIDERATIONS

EPA Waste ID Number: None
Special Instructions (Disposal): Dilute material with excess water making a weaker than 5% solution. Adjust to a pH between 6 and 9 with an alkali, such as soda ash or sodium bicarbonate. Open cold water tap completely, slowly pour the reacted material to the drain.
Empty Containers: Rinse three times with an appropriate solvent. Dispose of empty container as normal trash.
NOTICE (Disposal): These disposal guidelines are based on federal regulations and may be superseded by more stringent state or local requirements. Please consult your local environmental regulators for more information.

14. TRANSPORT INFORMATION

D.O.T.:
D.O.T. Proper Shipping Name: Not Currently Regulated
—
DOT Hazard Class: NA
DOT Subsidiary Risk: NA
DOT ID Number: NA
DOT Packing Group: NA
I.C.A.O.:
I.C.A.O. Proper Shipping Name: Not Currently Regulated
—
ICAO Hazard Class: NA
ICAO Subsidiary Risk: NA
ICAO ID Number: NA
ICAO Packing Group: NA
I.M.O.:
I.M.O. Proper Shipping Name: Not Currently Regulated
—
I.M.O. Hazard Class: NA
I.M.O. Subsidiary Risk: NA
I.M.O. ID Number: NA
I.M.O. Packing Group: NA
Additional Information: This product may be shipped as part of a chemical kit composed of various compatible dangerous goods for analytical or testing purposes. This kit would have the following classification: Proper Shipping Name: Chemical Kit Hazard Class: 9 UN Number 3316

15. REGULATORY INFORMATION

U.S. Federal Regulations:
O.S.H.A.: This product meets the criteria for a hazardous substance as defined in the Hazard Communication Standard. (29 CFR 1910.1200)
E.P.A.:
S.A.R.A. Title III Section 311/312 Categorization (40 CFR 370): Immediate (Acute) Health Hazard
S.A.R.A. Title III Section 313 (40 CFR 372): This product does NOT contain any chemical subject to the reporting requirements of Section 313 of Title III of SARA.
—
302 (EHS) TPQ (40 CFR 355): Not applicable
304 CERCLA RQ (40 CFR 302.4): Not applicable
304 EHS RQ (40 CFR 355): Not applicable
Clean Water Act (40 CFR 116.4): Not applicable
RCRA: Contains no RCRA regulated substances.
C.P.S.C.: Not applicable
State Regulations:
California Prop. 65: No Prop. 65 listed chemicals are present in this product.
Identification of Prop. 65 Ingredient(s): None

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MATERIAL SAFETY DATA SHEET

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Name: Ammonia Cyanurate Reagent Powder Pillows
Catalog Number: 2395566

Hach Company
P.O.Box 389
Loveland, CO USA 80539
(970) 669-3050

Emergency Telephone Numbers:
(Medical and Transportation)
(303) 623-5716 24 Hour Service
(515)232-2533 8am - 4pm CST

MSDS Number: M00128
Chemical Name: Not Applicable
CAS No.: Not Applicable
Chemical Formula: Not Applicable
Chemical Family: Not applicable
Hazard: Causes burns.
Date of MSDS Preparation:
Day: 20
Month: June
Year: 2003

2. COMPOSITION / INFORMATION ON INGREDIENTS

Sodium Dichloroisocyanurate
CAS No.: 2893-78-9
TSCA CAS Number: 2893-78-9
Percent Range: 1.0 - 5.0
Percent Range Units: weight / weight
LD50: Oral rat LD50 = 1400 mg/kg; Oral human LDLo = 3570 mg/kg
LC50: None reported
TLV: Not established
PEL: Not established
Hazard: Oxidizer. Causes eye burns.

Lithium Hydroxide, Anhydrous
CAS No.: 1310-65-2
TSCA CAS Number: 1310-65-2
Percent Range: 1.0 - 5.0
Percent Range Units: weight / weight
LD50: Oral rat LD50 = 225 mg/kg
LC50: Inhalation rat LC50 = 980 mg/m^3/4H
TLV: STEL 2 mg/m^3 (ceiling)
PEL: 2 mg/m^3
Hazard: Toxic. Causes severe burns.

Sodium Citrate
CAS No.: 68-04-2
TSCA CAS Number: 68-04-2
Percent Range: 80.0 - 90.0
Percent Range Units: weight / weight
LD50: Oral rat LD50 >8 g/Kg
LC50: None reported
TLV: Not established
PEL: Not established
Hazard: May cause irritation.

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Ingestion (First Aid): Do not induce vomiting. Give 1-2 glasses of water. Call physician immediately. Never give anything by mouth to an unconscious person.
Inhalation: Remove to fresh air. Give artificial respiration if necessary. Call physician.

5. FIRE FIGHTING MEASURES

Flammable Properties: During a fire, irritating and highly toxic gases may be generated by thermal decomposition.
Flash Point: Not applicable
Method: Not applicable
Flammability Limits:
Lower Explosion Limits: Not applicable
Upper Explosion Limits: Not applicable
Autoignition Temperature: Not determined
Hazardous Combustion Products: May emit toxic and corrosive fumes.
Fire / Explosion Hazards: Not combustible.
Static Discharge: None reported.
Mechanical Impact: None reported
Extinguishing Media: Dry chemical. Carbon dioxide Water.
Fire Fighting Instruction: As in any fire, wear self-contained breathing apparatus pressure-demand and full protective gear.

6. ACCIDENTAL RELEASE MEASURES

Spill Response Notice:
Only persons properly qualified to respond to an emergency involving hazardous substances may respond to a spill according to federal regulations (OSHA 29 CFR 1910.120(a)(v)) and per your company's emergency response plan and guidelines/procedures. See Section 13, Special Instructions for disposal assistance.
Containment Technique: Cover spilled solid material with sand or other inert material. Stop spilled material from being released to the environment.
Clean-up Technique: Scoop up spilled material into a large beaker and dissolve with water. Adjust to a pH between 6 and 9 with an acid, such as sulfuric or citric. Flush reacted material to the drain with a large excess of water. Decontaminate the area of the spill with a soap solution.
Evacuation Procedure: Evacuate local area (15 foot radius or as directed by your facility's emergency response plan) when: any quantity is spilled. If conditions warrant, increase the size of the evacuation.
Special Instructions (for accidental release): Not applicable
304 EHS RQ (40 CFR 355): Not applicable
D.O.T. Emergency Response Guide Number: 154

7. HANDLING / STORAGE

Handling: Avoid contact with eyes skin clothing Do not breathe dust. Wash thoroughly after handling. Maintain general industrial hygiene practices when using this product.
Storage: Protect from: heat moisture Store away from: acids / acid fumes.
Flammability Class: Not applicable

8. EXPOSURE CONTROLS / PROTECTIVE EQUIPMENT

Engineering Controls: Have an eyewash station nearby. Have a safety shower nearby. Use a fume hood to avoid exposure to dust, mist or vapor. Maintain general industrial hygiene practices when using this product.
Personal Protective Equipment:
Eye Protection: safety glasses with top and side shields
Skin Protection: disposable latex gloves lab coat
Inhalation Protection: adequate ventilation
Precautionary Measures: Avoid contact with: eyes skin clothing Do not breathe: dust Wash thoroughly after handling. Keep away from: acids/acid fumes metals
TLV: Not established
PEL: Not established

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NOTICE (Disposal): These disposal guidelines are based on federal regulations and may be superseded by more stringent state or local requirements. Please consult your local environmental regulators for more information.

14. TRANSPORT INFORMATION

D.O.T.:
D.O.T. Proper Shipping Name: Lithium Hydroxide Mixture
—
DOT Hazard Class: 8
DOT Subsidiary Risk: NA
DOT ID Number: UN2680
DOT Packing Group: II

I.C.A.O.:
I.C.A.O. Proper Shipping Name: Lithium Hydroxide Mixture
—
ICAO Hazard Class: 8
ICAO Subsidiary Risk: NA
ICAO ID Number: UN2680
ICAO Packing Group: II

I.M.O.:
I.M.O. Proper Shipping Name: Lithium Hydroxide Mixture
—
I.M.O. Hazard Class: 8
I.M.O. Subsidiary Risk: NA
I.M.O. ID Number: UN2680
I.M.O. Packing Group: II

Additional Information: This product may be shipped as part of a chemical kit composed of various compatible dangerous goods for analytical or testing purposes. This kit would have the following classification: Proper Shipping Name: Chemical Kit Hazard Class: 9 UN Number 3316

15. REGULATORY INFORMATION

U.S. Federal Regulations:
O.S.H.A.: This product meets the criteria for a hazardous substance as defined in the Hazard Communication Standard (29 CFR 1910.1200)
E.P.A.:
S.A.R.A. Title III Section 311/312 Categorization (40 CFR 370): Delayed (Chronic) Health Hazard Immediate (Acute) Health Hazard
S.A.R.A. Title III Section 313 (40 CFR 372): This product does NOT contain any chemical subject to the reporting requirements of Section 313 of Title III of SARA.
—
302 (EHS) TPQ (40 CFR 355): Not applicable
304 CERCLA RQ (40 CFR 302.4): Not applicable
304 EHS RQ (40 CFR 355): Not applicable
Clean Water Act (40 CFR 116.4): Not applicable
RCRA: Contains no RCRA regulated substances.
C.P.S.C.: Not applicable

State Regulations:
California Prop. 65: No Prop. 65 listed chemicals are present in this product.
Identification of Prop. 65 Ingredient(s): Not applicable

Trade Secret Registry: Not applicable

National Inventories:
U.S. Inventory Status: All ingredients in this product are listed on the TSCA 8(b) Inventory (40 CFR 710).
TSCA CAS Number: Not applicable

16. OTHER INFORMATION

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MATERIAL SAFETY DATA SHEET

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Name: Ammonia Salicylate Reagent Powder Pillows
Catalog Number: 2395366

Hach Company
P.O.Box 389
Loveland, CO USA 80539
(970) 669-3050

Emergency Telephone Numbers:
(Medical and Transportation)
(303) 623-5716 24 Hour Service
(515)232-2533 8am - 4pm CST

MSDS Number: M00127
Chemical Name: Not applicable
CAS No.: Not applicable
Chemical Formula: Not applicable
Chemical Family: Not applicable
Hazard: May cause irritation. Harmful if swallowed
Date of MSDS Preparation:
Day: 22
Month: 09
Year: 2004

2. COMPOSITION / INFORMATION ON INGREDIENTS

Sodium Salicylate
CAS No.: 54-21-7
TSCA CAS Number: 54-21-7
Percent Range: 40.0 - 50.0
Percent Range Units: weight / weight
LD50: Oral rat LD_{50} = 1200 mg/kg; Oral mouse LD_{50} = 540 mg/kg; Oral rabbit LD_{50} = 1700 mg/kg.
LC50: None reported.
TLV: Not established.
PEL: Not established.
Hazard: May cause irritation. Experimental teratogen. Experimental mutagen. May be embryotoxic.

Sodium Nitroferricyanide
CAS No.: 14402-89-2
TSCA CAS Number: 14402-89-2
Percent Range: < 1.0
Percent Range Units: weight / weight
LD50: Oral rat LD_{50} = 99 mg/kg (anhydrous).
LC50: None reported.
TLV: 5 mg/m³ as CN^-
PEL: 5 mg/m³ as CN^-
Hazard: Highly toxic. Harmful if inhaled.

Other components, each
CAS No.: Not applicable
TSCA CAS Number: Not applicable
Percent Range: 0.1 - 1.0
Percent Range Units: weight / weight
LD50: Not applicable
LC50: Not applicable
TLV: Not established
PEL: Not established
Hazard: Any ingredient(s) of this product listed as "Other component(s)" is not considered a health hazard to the user of this product.

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Chronic Effects: Chronic overexposure may cause confusion diarrhea fatigue weakness death Salicylates may cause ringing in the ears (tinnitus), abnormal bleeding, gastric ulceration, mental deterioration, skin eruption, temporary vision loss, and other optical effects.
Cancer / Reproductive Toxicity Information:
This product does NOT contain any OSHA listed carcinogens.

This product does NOT contain any IARC listed chemicals.

This product does NOT contain any NTP listed chemicals.

Additional Cancer / Reproductive Toxicity Information: Contains: an experimental mutagen. an experimental teratogen.
Toxicologically Synergistic Products: None reported

4. FIRST AID

Eye Contact: Immediately flush eyes with water for 15 minutes. Call physician.
Skin Contact (First Aid): Wash skin with soap and plenty of water. Remove contaminated clothing. Call physician immediately.
Ingestion (First Aid): Induce vomiting using syrup of ipecac or by sticking finger down throat. Never give anything by mouth to an unconscious person. Call physician immediately.
Inhalation: Remove to fresh air. Give artificial respiration if necessary. Call physician.

5. FIRE FIGHTING MEASURES

Flammable Properties: During a fire, this product decomposes to form toxic gases.
Flash Point: Not applicable
Method: Not applicable
Flammability Limits:
Lower Explosion Limits: Not applicable
Upper Explosion Limits: Not applicable
Autoignition Temperature: Not determined.
Hazardous Combustion Products: May emit acrid smoke and fumes.
Fire / Explosion Hazards: This product will not burn or explode.
Static Discharge: None reported.
Mechanical Impact: None reported
Extinguishing Media: Dry chemical. Carbon dioxide Alcohol foam.
Fire Fighting Instruction: As in any fire, wear self-contained breathing apparatus pressure-demand and full protective gear. Evacuate area and fight fire from a safe distance.

6. ACCIDENTAL RELEASE MEASURES

Spill Response Notice:
Only persons properly qualified to respond to an emergency involving hazardous substances may respond to a spill according to federal regulations (OSHA 29 CFR 1910.120(a)(v)) and per your company's emergency response plan and guidelines/procedures. See Section 13, Special Instructions for disposal assistance.
Containment Technique: Releases of this material may contaminate the environment. Stop spilled material from being released to the environment.
Clean-up Technique: Avoid contact with spilled material. Sweep up material. Dilute with a large excess of water. Flush the spilled material to the drain with a large excess of water. Decontaminate the area of the spill with a soap solution.
Evacuation Procedure: Evacuate local area (15 foot radius or as directed by your facility's emergency response plan) when: a pound or more of loose powder is spilled. If conditions warrant, increase the size of the evacuation.
Special Instructions (for accidental release): Mixture contains a component which is regulated as hazardous waste.
304 EHS RQ (40 CFR 355): Not applicable
D.O.T. Emergency Response Guide Number: None

7. HANDLING / STORAGE

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Reproductive Effects Data: None reported.
Ingredient Toxicological Data: Sodium Salicylate: Oral rat LD_{50} = 1200 mg/kg; Sodium Citrate: Oral rat LD_{50} > 8 g/kg; Sodium Tartrate: Oral rabbit LD_{50} = 5290 mg/kg; Sodium Nitroferricyanide: Oral rat LD_{50} = 99 mg/kg.

12. ECOLOGICAL INFORMATION

Product Ecological Information: --
No ecological data available for this product.
Ingredient Ecological Information: --
No ecological data available for the ingredients of this product.

13. DISPOSAL CONSIDERATIONS

EPA Waste ID Number: None
Special Instructions (Disposal): Dilute to 3 to 5 times the volume with cold water. Flush system with plenty of water.
Empty Containers: Rinse three times with an appropriate solvent. Dispose of empty container as normal trash.
NOTICE (Disposal): These disposal guidelines are based on federal regulations and may be superseded by more stringent state or local requirements. Please consult your local environmental regulators for more information.

14. TRANSPORT INFORMATION

D.O.T.:
D.O.T. Proper Shipping Name: Not Currently Regulated
--
DOT Hazard Class: NA
DOT Subsidiary Risk: NA
DOT ID Number: NA
DOT Packing Group: NA
I.C.A.O.:
I.C.A.O. Proper Shipping Name: Not Currently Regulated
--
ICAO Hazard Class: NA
ICAO Subsidiary Risk: NA
ICAO ID Number: NA
ICAO Packing Group: NA
I.M.O.:
I.M.O. Proper Shipping Name: Not Currently Regulated
--
I.M.O. Hazard Class: NA
I.M.O. Subsidiary Risk: NA
I.M.O. ID Number: NA
I.M.O. Packing Group: NA
Additional Information: This product may be shipped as part of a chemical kit composed of various compatible dangerous goods for analytical or testing purposes. This kit would have the following classification: Proper Shipping Name: Chemical Kit Hazard Class: 9 UN Number 3316

15. REGULATORY INFORMATION

U.S. Federal Regulations:
O.S.H.A.: This product meets the criteria for a hazardous substance as defined in the Hazard Communication Standard. (29 CFR 1910.1200)
E.P.A.:
S.A.R.A. Title III Section 311/312 Categorization (40 CFR 370): Immediate (Acute) Health Hazard Delayed (Chronic) Health Hazard
S.A.R.A. Title III Section 313 (40 CFR 372): This product contains a chemical(s) subject to the reporting requirements of Section 313 of Title III of SARA.
Sodium Nitroferricyanide.

MATERIAL DATA SAFETY SHEET

Identity: Eyesaline® solution - Product #s 32-000400, 32-000401, 32-000433, 32-000445, 32-00446, 32-000448, 32-000449, 32-000450, 32-000451, 32-000452, 32-000454, 32-000455, 32-000456, 32-000457, 32-000458, 32-000460, 32-000461, 32-000462, 32-000463, 32-000470, 32-000471, 32-000492, 32-000493, 32-000494, 32-000496, 32-000502, 32-000504, 32-000505, 32-000506, 32-000507, 32-000508, 32-000510, 32-000512, 32-000533, 32-000534, 32-000535, 32-001060, 32-001170

Manufacturer: Fendall, Inc.	**Emergency Telephone:** 1-401-232-1200
Address: 825 East Highway 151 Platteville, WI 53818 USA	**Information Telephone:** 800-543-4842 **Date Prepared:** 05/01/03

Hazardous Components (Specific Chemical Identity; Common Name(s))	OSHA PEL	ACGIH TLV	Other limits recommended	% (optional)
BENZALKONIUM CHLORIDE CAS #8001-54-5	NONE	NONE	N/A	<0.1%

Boiling Point: 200°F (93.3°C)	**Specific Gravity (H2O)=1:** NOT DETERMINED
Vapor Pressure (mm Hg.): 760	**Melting Point:** N/A
Vapor Density (Air = 1): NOT DETERMINED.	**Evaporation Rate (Butyl Acetate = 1):** NOT DETERMINED

Solubility in Water: 100%

Appearance and Odor: COLORLESS LIQUID WITH NO DISCERNABLE ODOR.

Flash Point (Method Used): N/A	**Flammable Limits:**	**LEL:** N/A	**UEL:** N/A

Extinguishing Media: THIS IS A NONFLAMMABLE AQUEOUS SOLUTION.

Special Fire Fighting Procedures: N/A

Unusual Fire and Explosion Hazards: N/A

Stability	**Unstable:** NO **Stable:** YES	**Conditions to Avoid:** THIS PRODUCT IS STABLE AND CONSIDERED NON-REACTIVE UNDER NORMAL CONDITIONS OF STORAGE AND USAGE.

Incompatibility (Materials to Avoid): NONE KNOWN

Hazardous Decomposition or Byproducts: NONE

Hazardous Polymerization	**May Occur:** NO **Will Not Occur:** YES	**Conditions to Avoid:** NONE

Route(s) of Entry: **Inhalation?** NO **Skin?** NO **Ingestion?** YES

Health Hazards (Acute and Chronic): INGESTION OF VOLUMES IN EXCESS OF 20 LITERS MAY CAUSE GASTRIC IRRITATION.

Carcinogenicity: **NTP?** NO **IARC Monographs?** NO **OSHA Regulated?** NO

Signs and Symptoms of Exposure: N/A

Medical Conditions Generally Aggravated by Exposure: N/A

Emergency First Aid Procedures: NOTES TO PHYSICIAN: IN THE UNLIKELY EVENT OF RAPID INGESTION OF LARGE VOLUMES OF THE SOLUTION, INDUCE VOMITING AND OBSERVE THE PATIENT FOR GASTRIC IRRITATION.

Steps to Be Taken In Case Material Is Released or Spilled: FLUSH AREA WITH WATER. THE SOLUTION IS NOT RCRA HAZARDOUS WASTE.

Waste Disposal Method: N/A

Precautions to Be Taken in Handling and Storing: DO NOT FREEZE OR EXPOSE TO TEMPERATURES IN EXCESS OF 110°F (43°C) FOR EXTENDED PERIODS.

Other Precautions: N/A

Respiratory Protection: N/A

Ventilation	**Local Exhaust:** N/A **Mechanical:** N/A	**Special:** N/A **Other:** N/A

Protective Gloves: N/A **Eye Protection:** N/A

Other Protective Clothing: N/A

Work Hygienic Practices: N/A

MSDS 4163

Ultimate ACID EATER™

Material Safety Data Sheet

CLIFT INDUSTRIES, INC.
CORPORATE: 800-996-9901
PO BOX 67153
CHARLOTTE, NC 28226

CHEMTREC: 800-424-9300

DATE PREPARED: 11/12/98
DATE REVISED: 11/12/01
DATE OF ORIGINATION: 11/12/98

1= Slight
2= Moderate
3= High
4= Extreme
0= Insignificant

HAZARD RATING	
HEALTH	1
FIRE	0
REACTIVITY	0
P.P.E.	D

I. PRODUCT IDENTIFICATION:

Ultimate ACID EATER™

COMMON NAME:	CLEANING COMPOUND
GENERIC NAME:	CLEANER
CHEMICAL:	MIXTURE

II. HAZARDOUS INGREDIENTS:

Ingredients	CAS	%	OSHA PEL ACGIH TLV

No Hazardous Ingredients

III. PHYSICAL/CHEMICAL CHARACTERISTICS:

BOILING POINT:	212	APPEARANCE:	RED
SPECIFIC GRAVITY:	1.1499	FORM:	LIQUID
MELTING POINT:	N/D	ODOR:	AMINE
EVAPORATION RATE:	N/D	VAPOR DENSITY:	N/D
SOLUBILITY (H20, 25C)	SOLUBLE	pH:	10
VOLATIZES CONTENT:	25	VOC (g/L)	N/D

IV. FIRE AND EXPLOSION HAZARD DATA:

FLASH POINT: DEGREES MORE THAN 300°F
LEL: N/D
UEL: ND

AUTOIGNITION TEMPERATURE: N/D

EXTINGUISHING MEDIA: Product will not support flames. Water may be used to cool fire-exposed containers. Wear self-contained breathing apparatus.

UNUSUAL FIRE/ EXPLOSION HAZARDS: Closed containers exposed to heat may rupture due to pressure.

HAZARDOUS DECOMPOSITION PRODUCTS: NONE KNOWN

V. REACTIVITY:

STABILITY: Stable
CONDITIONS TO AVOID: None known

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(970) 669-3050

MATERIAL SAFETY DATA SHEET

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Name: Acid Digestion Vials for Mid Range TOC
Catalog Number: 2817100

Hach Company
P.O.Box 389
Loveland, CO USA 80539
(970) 669-3050

Emergency Telephone Numbers:
(Medical and Transportation)
(303) 623-5716 24 Hour Service
(515)232-2533 8am - 4pm CST

MSDS Number: M01943
Chemical Name: Not applicable
CAS No.: Not applicable
Chemical Formula: Not applicable
Chemical Family: Not applicable
Hazard: Carcinogen. Causes eye burns. May cause irritation.
Date of MSDS Preparation:
Day: 24
Month: 09
Year: 2004

2. COMPOSITION / INFORMATION ON INGREDIENTS

Demineralized Water
CAS No.: 7732-18-5
TSCA CAS Number: 7732-18-5
Percent Range: 90.0 - 100.0
Percent Range Units: volume / volume
LD50: None reported
LC50: None reported
TLV: Not established
PEL: Not established
Hazard: No effects anticipated.

Sulfuric Acid
CAS No.: 7664-93-9
TSCA CAS Number: 7664-93-9
Percent Range: 1.0 - 5.0
Percent Range Units: volume / volume
LD50: Oral rat LD50 = 2140 mg/kg.
LC50: Inhalation rat LC50 = 87 ppm/4 hr
TLV: 1 mg/m³ (TWA); 3 mg/m³ (STEL)
PEL: 1 mg/m³
Hazard: Causes severe burns. Harmful if inhaled. Recognized carcinogen.

3. HAZARDS IDENTIFICATION

Emergency Overview:
Appearance: Clear, colorless liquid
Odor: Acidic
CAUSES EYE BURNS MAY CAUSE RESPIRATORY TRACT IRRITATION
CANCER HAZARD CONTAINS SULFURIC ACID WHICH CAN CAUSE CANCER

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(970) 669-3050

6. ACCIDENTAL RELEASE MEASURES

Spill Response Notice:
Only persons properly qualified to respond to an emergency involving hazardous substances may respond to a spill according to federal regulations (OSHA 29 CFR 1910.120(a)(v)) and per your company's emergency response plan and guidelines/procedures. See Section 13, Special Instructions for disposal assistance.
Containment Technique: Absorb spilled liquid with non-reactive sorbent material. Stop spilled material from being released to the environment.
Clean-up Technique: Cover spilled material with an alkali, such as soda ash or sodium bicarbonate. Scoop up slurry into a large beaker. Adjust to a pH between 6 and 9 with an alkali, such as soda ash or sodium bicarbonate. Flush reacted material to the drain with a large excess of water. Decontaminate the area of the spill with a soap solution.
Evacuation Procedure: Evacuate local area (15 foot radius or as directed by your facility's emergency response plan) when: If conditions warrant, increase the size of the evacuation. a gallon or more of liquid is spilled. If conditions warrant, increase the size of the evacuation.
Special Instructions (for accidental release): Mixture contains a component which is regulated as a water pollutant. Product is regulated as RCRA hazardous waste.
304 EHS RQ (40 CFR 355): Sulfuric Acid - RQ 1000 lbs.
D.O.T. Emergency Response Guide Number: 154

7. HANDLING / STORAGE

Handling: Avoid contact with eyes Do not breathe mist or vapors. Use with adequate ventilation. Maintain general industrial hygiene practices when using this product. Wash thoroughly after handling.
Storage: Store between 10° and 25°C. Keep container tightly closed when not in use.
Flammability Class: Not applicable

8. EXPOSURE CONTROLS / PROTECTIVE EQUIPMENT

Engineering Controls: Have an eyewash station nearby. Use general ventilation to minimize exposure to mist, vapor or dust. Maintain general industrial hygiene practices when using this product.
Personal Protective Equipment:
Eye Protection: chemical splash goggles
Skin Protection: disposable latex gloves lab coat
Inhalation Protection: adequate ventilation
Precautionary Measures: Avoid contact with: eyes skin Do not breathe: mist/vapor Use with adequate ventilation. Protect from: heat Wash thoroughly after handling.
TLV: Not Established
PEL: Not Established

9. PHYSICAL / CHEMICAL PROPERTIES

Appearance: Clear, colorless liquid
Physical State: Liquid
Molecular Weight: Not Applicable
Odor: Acidic
pH: < 0.5
Vapor Pressure: Not Determined
Vapor Density (air = 1): Not Determined
Boiling Point: ~ 100°C
Melting Point: Not Determined
Specific Gravity (water = 1): Not Determined
Evaporation Rate (water = 1): Not Determined
Volatile Organic Compounds Content: Not Applicable
Partition Coefficient (n-octanol / water): Not Applicable
Solubility:
Water: Miscible
Acid: Miscible
Other: Not Determined

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(970) 669-3050

I.M.O.:

I.M.O. Proper Shipping Name: Corrosive Liquid, Acidic, Inorganic, N.O.S. (<10% Sulphuric Acid in Solution)
I.M.O. Hazard Class: 8
I.M.O. Subsidiary Risk: NA
I.M.O. ID Number: UN3264
I.M.O. Packing Group: III

Additional Information: This product may be shipped as part of a chemical kit composed of various compatible dangerous goods for analytical or testing purposes. This kit would have the following classification: Proper Shipping Name: Chemical Kit Hazard Class: 9 UN Number 3316

15. REGULATORY INFORMATION

U.S. Federal Regulations:

O.S.H.A.: This product meets the criteria for a hazardous substance as defined in the Hazard Communication Standard. (29 CFR 1910.1200)

E.P.A.:

S.A.R.A. Title III Section 311/312 Categorization (40 CFR 370): Immediate (Acute) Health Hazard Delayed (Chronic) Health Hazard

S.A.R.A. Title III Section 313 (40 CFR 372): This product contains a chemical(s) subject to the reporting requirements of Section 313 of Title III of SARA.
Sulfuric acid

302 (EHS) TPQ (40 CFR 355): Sulfuric Acid 1000 lbs.
304 CERCLA RQ (40 CFR 302.4): Sulfuric Acid 1000 lbs.
304 EHS RQ (40 CFR 555): Sulfuric Acid - RQ 1000 lbs.
Clean Water Act (40 CFR 116.4): Sulfuric acid - RQ 1000 lbs.
RCRA: Contains RCRA regulated substances. See Section 13, EPA Waste ID Number.

C.P.S.C.: Not applicable

State Regulations:

California Prop. 65: No Prop. 65 listed chemicals are present in this product.
Identification of Prop. 65 Ingredient(s): None

Trade Secret Registry: Not applicable

National Inventories:

U.S. Inventory Status: All ingredients in this product are listed on the TSCA 8(b) Inventory (40 CFR 710).
TSCA CAS Number: Not Applicable

16. OTHER INFORMATION

Intended Use: Digestion reagent

References: TLV's Threshold Limit Values and Biological Exposure Indices for 1992-1993. American Conference of Governmental Industrial Hygienists, 1992. In-house information. Technical Judgment. Air Contaminants, Federal Register, Vol. 54, No. 12. Thursday, January 19, 1989. pp. 2332-2983. Vendor Information. IARC Monographs on the Evaluation of the Carcinogenic Risks to Humans. World Health Organization (Volumes 1-42) Supplement 7. France: 1987.

Revision Summary: Updates in Section(s) 14,

Legend:

NA - Not Applicable	w/w - weight/weight
ND - Not Determined	w/v - weight/volume
NV - Not Available	v/v - volume/volume

USER RESPONSIBILITY: Each user should read and understand this information and incorporate it in individual site safety programs in accordance with applicable hazard communication standards and regulations.

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Loveland, CO USA 80539
(970) 669-3050

MATERIAL SAFETY DATA SHEET

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Name: SulfaVer ® 4 Sulfate Reagent
Catalog Number: 1206599

Hach Company
P.O.Box 389
Loveland, CO USA 80539
(970) 669-3050

Emergency Telephone Numbers:
(Medical and Transportation)
(303) 623-5716 24 Hour Service
(515)232-2533 8am - 4pm CST

MSDS Number: M00046
Chemical Name: Not applicable
CAS No.: Not applicable
Chemical Formula: Not applicable
Chemical Family: Not applicable
Hazard: Causes severe eye irritation.
Date of MSDS Preparation:
Day: 13
Month: 12
Year: 2004

2. COMPOSITION / INFORMATION ON INGREDIENTS

Barium Chloride
CAS No.: 10326-27-9
TSCA CAS Number: 10361-37-2
Percent Range: 40.0 - 50.0
Percent Range Units: weight / weight
LD50: Oral rat LD50 = 118 mg/kg Oral Human LDLo = 11400 µg/kg
LC50: None reported
TLV: 0.5 mg/m^3 as Ba
PEL: 0.5 mg/m^3 as Ba
Hazard: May cause irritation. Toxic.

Citric Acid
CAS No.: 77-92-9
TSCA CAS Number: 77-92-9
Percent Range: 55.0 - 65.0
Percent Range Units: weight / weight
LD50: Oral rat LD50 = 6730 mg/Kg
LC50: None reported
TLV: Not established
PEL: Not established
Hazard: Causes severe eye irritation.

3. HAZARDS IDENTIFICATION

Emergency Overview:
Appearance: White powder
Odor: None
CAUSES EYE IRRITATION MAY CAUSE SKIN AND RESPIRATORY TRACT IRRITATION

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Mechanical Impact: None reported
Extinguishing Media: Use media appropriate to surrounding fire conditions
Fire Fighting Instruction: As in any fire, wear self-contained breathing apparatus pressure-demand and full protective gear.

6. ACCIDENTAL RELEASE MEASURES

Spill Response Notice:
Only persons properly qualified to respond to an emergency involving hazardous substances may respond to a spill according to federal regulations (OSHA 29 CFR 1910.120(a)(v)) and per your company's emergency response plan and guidelines/procedures. See Section 13, Special Instructions for disposal assistance.
Containment Technique: Releases of this material may contaminate the environment. Stop spilled material from being released to the environment.
Clean-up Technique: Avoid contact with spilled material. Sweep up material. Dispose of material in an E.P.A. approved hazardous waste facility. Decontaminate the area of the spill with a soap solution.
Evacuation Procedure: Evacuate local area (15 foot radius or as directed by your facility's emergency response plan) when: any quantity is spilled. If conditions warrant, increase the size of the evacuation.
Special Instructions (for accidental release): Mixture contains a component which is regulated as hazardous waste.
304 EHS RQ (40 CFR 355): Not applicable
D.O.T. Emergency Response Guide Number: None

7. HANDLING / STORAGE

Handling: Avoid contact with: eyes skin clothing Do not breathe: dust. Wash thoroughly after handling. Maintain general industrial hygiene practices when using this product.
Storage: Store away from: oxidizers Protect from: moisture
Flammability Class: Not applicable

8. EXPOSURE CONTROLS / PROTECTIVE EQUIPMENT

Engineering Controls: Have an eyewash station nearby. Use a fume hood to avoid exposure to dust, mist or vapor. Maintain general industrial hygiene practices when using this product.
Personal Protective Equipment:
Eye Protection: safety glasses with top and side shields
Skin Protection: disposable latex gloves lab coat
Inhalation Protection: adequate ventilation
Precautionary Measures: Avoid contact with: eyes skin clothing Do not breathe: dust Wash thoroughly after handling. Protect from: moisture Keep away from: oxidizers
TLV: Not established
PEL: Not established

9. PHYSICAL / CHEMICAL PROPERTIES

Appearance: White powder
Physical State: Solid
Molecular Weight: Not applicable
Odor: None
pH: of a 5% solution ~ 2.0
Vapor Pressure: Not applicable
Vapor Density (air = 1): Not applicable
Boiling Point: Not applicable
Melting Point: ~ 124 °C (255 °F)
Specific Gravity (water = 1): ~2
Evaporation Rate (water = 1): Not applicable
Volatile Organic Compounds Content: Not applicable
Partition Coefficient (n-octanol / water): Not applicable
Solubility:
Water: Soluble

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ICAO Subsidiary Risk: NA
ICAO ID Number: NA
ICAO Packing Group: NA
I.M.O.:
I.M.O. Proper Shipping Name: Not Currently Regulated
--
I.M.O. Hazard Class: NA
I.M.O. Subsidiary Risk: NA
I.M.O. ID Number: NA
I.M.O. Packing Group: NA
Additional Information: This product may be shipped as part of a chemical kit composed of various compatible dangerous goods for analytical or testing purposes. This kit would have the following classification: Proper Shipping Name: Chemical Kit Hazard Class: 9 UN Number 3316

15. REGULATORY INFORMATION

U.S. Federal Regulations:
O.S.H.A.: This product meets the criteria for a hazardous substance as defined in the Hazard Communication Standard. (29 CFR 1910.1200)
E.P.A.:
S.A.R.A. Title III Section 311/312 Categorization (40 CFR 370): Immediate (Acute) Health Hazard Delayed (Chronic) Health Hazard
S.A.R.A. Title III Section 313 (40 CFR 372): This product contains a chemical(s) subject to the reporting requirements of Section 313 of Title III of SARA.
Barium Chloride
302 (EHS) TPQ (40 CFR 355): Not applicable
304 CERCLA RQ (40 CFR 302.4): Not applicable
304 EHS RQ (40 CFR 355): Not applicable
Clean Water Act (40 CFR 116.4): Not applicable
RCRA: Contains RCRA regulated substances. See Section 13, EPA Waste ID Number.
C.P.S.C.: Not applicable
State Regulations:
California Prop. 65: No Prop. 65 listed chemicals are present in this product.
Identification of Prop. 65 Ingredient(s): Not applicable
Trade Secret Registry: Not applicable
National Inventories:
U.S. Inventory Status: All ingredients in this product are listed on the TSCA 8(b) Inventory (40 CFR 710).
TSCA CAS Number: Not applicable

16. OTHER INFORMATION

Intended Use: Sulfate determination
References: TLV's Threshold Limit Values and Biological Exposure Indices for 1992-1993. American Conference of Governmental Industrial Hygienists, 1992. Air Contaminants, Federal Register, Vol. 54, No. 12. Thursday, January 19, 1989. pp. 2332-2983. In-house information. Technical Judgment. Outside Testing. Vendor Information. Gosselin, R. E. et al. Clinical Toxicology of Commercial Products, 5th Ed. Baltimore: The Williams and Wilkins Co., 1984. Sax, N. Irving. Dangerous Properties of Industrial Materials, 7th Ed. New York: Van Nostrand Reinhold Co., 1989. Patty, Frank A. Industrial Hygiene and Toxicology, 3rd Revised Edition. Volume 2. New York: A Wiley-Interscience Publication, 1981. NIOSH Registry of Toxic Effects of Chemical Substances, 1985-86. Cincinnati: U.S. Department of Health and Human Services, April, 1987.
Revision Summary: Updates in Section(s) 14,

Legend:

NA - Not Applicable	w/w - weight/weight
ND - Not Determined	w/v - weight/volume
NV - Not Available	v/v - volume/volume

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Hach Company
P.O.Box 389
Loveland, CO USA 80539
(970) 669-3050

MATERIAL SAFETY DATA SHEET

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Name: Acid Digestion Vials for Low Range TOC
Catalog Number: 2760300

Hach Company
P.O.Box 389
Loveland, CO USA 80539
(970) 669-3050

Emergency Telephone Numbers:
(Medical and Transportation)
(303) 623-5716 24 Hour Service
(515)232-2533 8am - 4pm CST

MSDS Number: M01741
Chemical Name: Not Applicable
CAS No.: Not Applicable
Chemical Formula: Not Applicable
Chemical Family: Not applicable
Hazard: Carcinogen. Causes eye burns.
Date of MSDS Preparation:
Day: 24
Month: 09
Year: 2004

2. COMPOSITION / INFORMATION ON INGREDIENTS

Demineralized Water
CAS No.: 7732-18-5
TSCA CAS Number: 7732-18-5
Percent Range: 80.0 - 90.0
Percent Range Units: volume / volume
LD50: None reported
LC50: None reported
TLV: Not established
PEL: Not established
Hazard: No effects anticipated.

Sulfuric Acid
CAS No.: 7664-93-9
TSCA CAS Number: 7664-93-9
Percent Range: 5.0 - 15.0
Percent Range Units: weight / volume
LD50: Oral rat LD50 = 2140 mg/kg.
LC50: Inhalation rat LC50 = 87 ppm/4 hr
TLV: 1 mg/m³ (TWA); 3 mg/m³ (STEL)
PEL: 1 mg/m³
Hazard: Causes severe burns. Harmful if inhaled. Recognized carcinogen.

3. HAZARDS IDENTIFICATION

Emergency Overview:
Appearance: Clear, colorless liquid
Odor: None
CAUSES EYE BURNS HARMFUL IF INHALED MAY CAUSE SKIN IRRITATION
CANCER HAZARD CONTAINS SULFURIC ACID WHICH CAN CAUSE CANCER

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6. ACCIDENTAL RELEASE MEASURES

Spill Response Notice:
Only persons properly qualified to respond to an emergency involving hazardous substances may respond to a spill according to federal regulations (OSHA 29 CFR 1910.120(a)(v)) and per your company's emergency response plan and guidelines/procedures. See Section 13, Special Instructions for disposal assistance.
Containment Technique: Absorb spilled liquid with non-reactive sorbent material. Stop spilled material from being released to the environment.
Clean-up Technique: Cover spilled material with an alkali, such as soda ash or sodium bicarbonate. Scoop up slurry into a large beaker. Adjust to a pH between 6 and 9 with an alkali, such as soda ash or sodium bicarbonate. Dispose of material in an E.P.A. approved hazardous waste facility. Decontaminate the area of the spill with a soap solution.
Evacuation Procedure: Evacuate local area (15 foot radius or as directed by your facility's emergency response plan) when: any quantity is spilled. If conditions warrant, increase the size of the evacuation.
Special Instructions (for accidental release): Mixture contains a component which is regulated as a water pollutant. Mixture contains a component which is regulated as hazardous waste.
304 EHS RQ (40 CFR 355): Sulfuric Acid - RQ 1000 lbs.
D.O.T. Emergency Response Guide Number: 154

7. HANDLING / STORAGE

Handling: Avoid contact with eyes skin Do not breathe mist or vapors. Wash thoroughly after handling. Maintain general industrial hygiene practices when using this product.
Storage: Keep container tightly closed when not in use.
Flammability Class: Not applicable

8. EXPOSURE CONTROLS / PROTECTIVE EQUIPMENT

Engineering Controls: Have an eyewash station nearby. Have a safety shower nearby. Maintain adequate ventilation to keep vapor level below TWA for chemicals in this product. Maintain general industrial hygiene practices when using this product.
Personal Protective Equipment:
Eye Protection: safety glasses with top and side shields
Skin Protection: lab coat disposable latex gloves
Inhalation Protection: adequate ventilation
Precautionary Measures: Avoid contact with: eyes skin Do not breathe: mist/vapor Wash thoroughly after handling. Use with adequate ventilation.
TLV: Not Established
PEL: Not Established

9. PHYSICAL / CHEMICAL PROPERTIES

Appearance: Clear, colorless liquid
Physical State: Liquid
Molecular Weight: Not Applicable
Odor: None
pH: Not Determined
Vapor Pressure: Not Determined
Vapor Density (air = 1): Not Determined
Boiling Point: Not Determined
Melting Point: Not Determined
Specific Gravity (water = 1): Not Determined
Evaporation Rate (water = 1): Not Determined
Volatile Organic Compounds Content: Not Applicable
Partition Coefficient (n-octanol / water): Not Applicable
Solubility:
Water: Soluble
Acid: Soluble
Other: Not Determined

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ICAO Subsidiary Risk: NA
ICAO ID Number: UN3264
ICAO Packing Group: III
I.M.O.:
I.M.O. Proper Shipping Name: Corrosive Liquid, Acidic, Inorganic, N.O.S. (< 45% Sulfuric Acid in Solution)
I.M.O. Hazard Class: 8
I.M.O. Subsidiary Risk: NA
I.M.O. ID Number: UN3264
I.M.O. Packing Group: III
Additional Information: This product may be shipped as part of a chemical kit composed of various compatible dangerous goods for analytical or testing purposes. This kit would have the following classification: Proper Shipping Name: Chemical Kit Hazard Class: 9 UN Number 3316

15. REGULATORY INFORMATION

U.S. Federal Regulations:
O.S.H.A.: This product meets the criteria for a hazardous substance as defined in the Hazard Communication Standard. (29 CFR 1910.1200)
E.P.A.:
S.A.R.A. Title III Section 311/312 Categorization (40 CFR 370): Immediate (Acute) Health Hazard Delayed (Chronic) Health Hazard
S.A.R.A. Title III Section 313 (40 CFR 372): This product does NOT contain any chemical subject to the reporting requirements of Section 313 of Title III of SARA.

302 (EHS) TPQ (40 CFR 355): Sulfuric Acid 1000 lbs.
304 CERCLA RQ (40 CFR 302.4): Sulfuric Acid 1000 lbs.
304 EHS RQ (40 CFR 355): Sulfuric Acid - RQ 1000 lbs.
Clean Water Act (40 CFR 116.4): Sulfuric acid - RQ 1000 lbs.
RCRA: Contains RCRA regulated substances. See Section 13, EPA Waste ID Number.
C.P.S.C.: The label for this product bears the signal word "POISON" because the concentration of Sulfuric Acid in the product is greater than/equal to 10%.
State Regulations:
California Prop. 65: No Prop. 65 listed chemicals are present in this product.
Identification of Prop. 65 Ingredient(s): --
Trade Secret Registry: Not applicable
National Inventories:
U.S. Inventory Status: All ingredients in this product are listed on the TSCA 8(b) Inventory (40 CFR 710).
TSCA CAS Number: Not Applicable

16. OTHER INFORMATION

Intended Use: Determination of chromium
References: 29 CFR 1900 - 1910 (Code of Federal Regulations - Labor). Air Contaminants, Federal Register, Vol. 54, No. 12. Thursday, January 19, 1989. pp. 2332-2983. CCINFO RTECS. Canadian Centre for Occupational Health and Safety. Hamilton, Ontario Canada: 30 June 1993. IARC Monographs on the Evaluation of the Carcinogenic Risks to Humans. World Health Organization (Volumes 1-42) Supplement 7. France: 1987. List of Dangerous Substances Classified in Annex I of the EEC Directive (67/548) - Classification, Packaging and Labeling of Dangerous Substances, Amended July 1992. Outside Testing. Sixth Annual Report on Carcinogens, 1991. U.S. Department of Health and Human Services. Rockville, MD: Technical Resources, Inc. 1991. Technical Judgment. TLV's Threshold Limit Values and Biological Exposure Indices for 1992-1993. American Conference of Governmental Industrial Hygienists, 1992.
Revision Summary: Updates in Section(s) 14,

Legend:

NA - Not Applicable	w/w - weight/weight
ND - Not Determined	w/v - weight/volume

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MATERIAL SAFETY DATA SHEET

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Name: Low Range TOC Indicator Ampules
Catalog Number: 2789510

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(970) 669-3050

Emergency Telephone Numbers:
(Medical and Transportation)
(303) 623-5716 24 Hour Service
(515)232-2533 8am - 4pm CST

MSDS Number: M01742
Chemical Name: Not Applicable
CAS No.: Not Applicable
Chemical Formula: Not Applicable
Chemical Family: Not applicable
Hazard: Practically non-toxic. No effects anticipated.
Date of MSDS Preparation:
Day: 24
Month: 09
Year: 2004

2. COMPOSITION / INFORMATION ON INGREDIENTS

Demineralized Water
CAS No.: 7732-18-5
TSCA CAS Number: 7732-18-5
Percent Range: > 90.0
Percent Range Units: volume / volume
LD50: None reported
LC50: None reported
TLV: Not established
PEL: Not established
Hazard: No effects anticipated.

Other components, each
CAS No.: Not applicable
TSCA CAS Number: Not applicable
Percent Range: < 1.0
Percent Range Units: weight / volume
LD50: Not applicable
LC50: Not applicable
TLV: Not established
PEL: Not established
Hazard: Any ingredient(s) of this product listed as "Other component(s)" is not considered a health hazard to the user of this product.

3. HAZARDS IDENTIFICATION

Emergency Overview:
Appearance: Clear, blue liquid
Odor: None

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Spill Response Notice:
Only persons properly qualified to respond to an emergency involving hazardous substances may respond to a spill according to federal regulations (OSHA 29 CFR 1910.120(a)(v)) and per your company's emergency response plan and guidelines/procedures. See Section 13, Special Instructions for disposal assistance.
Containment Technique: Absorb spilled liquid with non-reactive sorbent material.
Clean-up Technique: Flush the spilled material to the drain with a large excess of water. Decontaminate the area of the spill with a soap solution.
Evacuation Procedure: Evacuate as needed to perform spill clean-up. If conditions warrant, increase the size of the evacuation.
Special Instructions (for accidental release): Not applicable
304 EHS RQ (40 CFR 355): Not applicable
D.O.T. Emergency Response Guide Number: None

7. HANDLING / STORAGE

Handling: Avoid contact with eyes Maintain general industrial hygiene practices when using this product.
Storage: Keep container tightly closed when not in use. Protect from: heat
Flammability Class: Not applicable

8. EXPOSURE CONTROLS / PROTECTIVE EQUIPMENT

Engineering Controls: Maintain general industrial hygiene practices when using this product.
Personal Protective Equipment:
Eye Protection: safety glasses with top and side shields
Skin Protection: Not applicable
Inhalation Protection: adequate ventilation
Precautionary Measures: Avoid contact with: eyes Wash thoroughly after handling. Protect from: heat
TLV: Not Established
PEL: Not Established

9. PHYSICAL / CHEMICAL PROPERTIES

Appearance: Clear, blue liquid
Physical State: Liquid
Molecular Weight: Not Applicable
Odor: None
pH: 10.15
Vapor Pressure: Not Determined
Vapor Density (air = 1): Not Determined
Boiling Point: Not Determined
Melting Point: Not Determined
Specific Gravity (water = 1): Not Determined
Evaporation Rate (water = 1): Not Determined
Volatile Organic Compounds Content: Not Applicable
Partition Coefficient (n-octanol / water): Not Applicable
Solubility:
Water: Soluble
Acid: Soluble
Other: Not Determined
Metal Corrosivity:
Steel: Not Determined
Aluminum: Not Determined

10. STABILITY / REACTIVITY

Chemical Stability: Stable when stored under proper conditions.
Conditions to Avoid: Heat Evaporation
Reactivity / Incompatibility: None reported

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15. REGULATORY INFORMATION

U.S. Federal Regulations:
O.S.H.A.: This product does not meet the criteria for a hazardous substance as defined in the Hazard Communication Standard. (29 CFR 1910.1200)
E.P.A.:
S.A.R.A. Title III Section 311/312 Categorization (40 CFR 370): This product is not hazardous under 29 CFR.1910.1200 and therefore is not covered by Title III under SARA.
S.A.R.A. Title III Section 313 (40 CFR 372): This product does NOT contain any chemical subject to the reporting requirements of Section 313 of Title III of SARA.

302 (EHS) TPQ (40 CFR 355): Not applicable
304 CERCLA RQ (40 CFR 302.4): Not applicable
304 EHS RQ (40 CFR 355): Not applicable
Clean Water Act (40 CFR 116.4): Not applicable
RCRA: Contains no RCRA regulated substances.
C.P.S.C.: Not applicable
State Regulations:
California Prop. 65: No Prop. 65 listed chemicals are present in this product.
Identification of Prop. 65 Ingredient(s): None
Trade Secret Registry: Not applicable
National Inventories:
U.S. Inventory Status: All ingredients in this product are listed on the TSCA 8(b) Inventory (40 CFR 710).
TSCA CAS Number: Not Applicable

16. OTHER INFORMATION

Intended Use: Indicator
References: 29 CFR 1900 - 1910 (Code of Federal Regulations - Labor). Technical Judgment. In-house information.
Revision Summary: Updates in Section(s) 14,

Legend:

NA - Not Applicable	w/w - weight/weight
ND - Not Determined	w/v - weight/volume
NV - Not Available	v/v - volume/volume

USER RESPONSIBILITY: Each user should read and understand this information and incorporate it in individual site safety programs in accordance with applicable hazard communication standards and regulations.

THE INFORMATION CONTAINED HEREIN IS BASED ON DATA CONSIDERED TO BE ACCURATE. HOWEVER, NO WARRANTY IS EXPRESSED OR IMPLIED REGARDING THE ACCURACY OF THESE DATA OR THE RESULTS TO BE OBTAINED FROM THE USE THEREOF.

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MATERIAL SAFETY DATA SHEET

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Name: TOC Persulfate
Catalog Number: 2790166

Hach Company
P.O.Box 389
Loveland, CO USA 80539
(970) 669-3050

Emergency Telephone Numbers:
(Medical and Transportation)
(303) 623-5716 24 Hour Service
(515)232-2533 8am - 4pm CST

MSDS Number: M00039
Chemical Name: Peroxydisulfuric Acid, Dipotassium Salt
CAS No.: 7727-21-1
Chemical Formula: $K_2S_2O_8$
Chemical Family: Oxidizing Agents
Hazard: Causes severe eye irritation. Oxidizer. Allergen
Date of MSDS Preparation:
Day: 22
Month: 09
Year: 2004

2. COMPOSITION / INFORMATION ON INGREDIENTS

Potassium Persulfate
CAS No.: 7727-21-1
TSCA CAS Number: 7727-21-1
Percent Range: 100.0
Percent Range Units: weight / weight
LD50: Oral Rat LD50 = 802 mg/kg
LC50: None reported
TLV: 5 mg/m^3
PEL: Not established
Hazard: Causes severe eye irritation. Oxidizer. Allergen

3. HAZARDS IDENTIFICATION

Emergency Overview:
Appearance: White to light yellow crystals
Odor: None
CAUSES EYE AND RESPIRATORY TRACT IRRITATION
MAY CAUSE ALLERGIC SKIN AND RESPIRATORY REACTIONS
STRONG OXIDIZER: CONTACT WITH OTHER MATERIAL MAY CAUSE FIRE

HMIS:
Health: 2
Flammability: 0
Reactivity: 0
Protective Equipment: X - See protective equipment, Section 8.
NFPA:
Health: 1
Flammability: 0
Reactivity: 0
Symbol: oxy
Potential Health Effects:

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Evacuation Procedure: Evacuate local area (15 foot radius or as directed by your facility's emergency response plan) when: a pound or more of loose powder is spilled. If conditions warrant, increase the size of the evacuation.
Special Instructions (for accidental release): Mixture contains a component which is regulated as hazardous waste.
304 EHS RQ (40 CFR 355): Not applicable
D.O.T. Emergency Response Guide Number: 140

7. HANDLING / STORAGE

Handling: Avoid contact with eyes skin Do not breathe dust. Wash thoroughly after handling. Maintain general industrial hygiene practices when using this product.
Storage: Keep away from: reducers oxidizable materials Protect from: moisture heat
Flammability Class: Not applicable

8. EXPOSURE CONTROLS / PROTECTIVE EQUIPMENT

Engineering Controls: Have an eyewash station nearby. Use a fume hood to avoid exposure to dust, mist or vapor.
Personal Protective Equipment:
Eye Protection: safety glasses with top and side shields
Skin Protection: lab coat disposable latex gloves
Inhalation Protection: laboratory fume hood
Precautionary Measures: Avoid contact with: eyes skin Do not breathe: dust Wash thoroughly after handling. Keep away from: oxidizable materials reducers
TLV: 5 mg/m^3
PEL: Not established

9. PHYSICAL / CHEMICAL PROPERTIES

Appearance: White to light yellow crystals
Physical State: Solid
Molecular Weight: 270.32
Odor: None
pH: of 5% solution = 4.1
Vapor Pressure: Not applicable
Vapor Density (air = 1): Not applicable
Boiling Point: Not applicable
Melting Point: Decomposes at >100°C or 212°F
Specific Gravity (water = 1): 2.477
Evaporation Rate (water = 1): Not applicable
Volatile Organic Compounds Content: 0.0%
Partition Coefficient (n-octanol / water): Not determined
Solubility:
Water: Soluble
Acid: Not determined
Other: Not determined
Metal Corrosivity:
Steel: 0.704 in/yr
Aluminum: 0.137 in/yr

10. STABILITY / REACTIVITY

Chemical Stability: Stable when stored under proper conditions.
Conditions to Avoid: Excess moisture Exposure to air. Heating to decomposition.
Reactivity / Incompatibility: May react violently in contact with: oxidizable material reducers
Hazardous Decomposition: Heating to decomposition releases toxic and/or corrosive fumes of: sulfur oxides
Hazardous Polymerization: Will not occur.

11. TOXICOLOGICAL INFORMATION

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(970) 669-3050

O.S.H.A.: This product meets the criteria for a hazardous substance as defined in the Hazard Communication Standard. (29 CFR 1910.1200)
E.P.A.:
S.A.R.A. Title III Section 311/312 Categorization (40 CFR 370): Immediate (Acute) Health Hazard Delayed (Chronic) Health Hazard Fire Hazard
S.A.R.A. Title III Section 313 (40 CFR 372): This product does NOT contain any chemical subject to the reporting requirements of Section 313 of Title III of SARA.

302 (EHS) TPQ (40 CFR 355): Not applicable
304 CERCLA RQ (40 CFR 302.4): Not applicable
304 EHS RQ (40 CFR 355): Not applicable
Clean Water Act (40 CFR 116.4): Not applicable
RCRA: Contains RCRA regulated substances. See Section 13, EPA Waste ID Number.
C.P.S.C.: Not applicable
State Regulations:
California Prop. 65: No Prop. 65 listed chemicals are present in this product.
Identification of Prop. 65 Ingredient(s): Not applicable
Trade Secret Registry: Not applicable
National Inventories:
U.S. Inventory Status: TSCA Listed: Yes
TSCA CAS Number: 7727-21-1

16. OTHER INFORMATION

Intended Use: Laboratory Reagent
References: TLV's Threshold Limit Values and Biological Exposure Indices for 1992-1993. American Conference of Governmental Industrial Hygienists, 1992. The Merck Index, 11th Ed. Rahway, New Jersey: Merck and Co., Inc., 1989. Technical Judgment. Sax, N. Irving. Dangerous Properties of Industrial Materials, 7th Ed. New York: Van Nostrand Reinhold Co., 1989. List of Dangerous Substances Classified in Annex I of the EEC Directive (67/548) - Classification, Packaging and Labeling of Dangerous Substances, Amended July 1992. In-house information. Fire Protection Guide on Hazardous Materials, 10th Ed. Quincy, MA: National Fire Protection Fire Protection Guide on Hazardous Materials, 10th Ed. Quincy, MA: National Fire Protection Association, 1991. CCINFO RTECS. Canadian Centre for Occupational Health and Safety. Hamilton, Ontario Canada: 30 June 1993. CCINFO MSDS/FTSS. Canadian Centre for Occupational Health and Safety. Hamilton, Ontario Canada: 30 June 1993. Air Contaminants, Federal Register, Vol. 54, No. 12. Thursday, January 19, 1989. pp. 2332-2983. 29 CFR 1900 - 1910 (Code of Federal Regulations - Labor).
Revision Summary: Updates in Section(s) 14,

Legend:

NA - Not Applicable	w/w - weight/weight
ND - Not Determined	w/v - weight/volume
NV - Not Available	v/v - volume/volume

USER RESPONSIBILITY: Each user should read and understand this information and incorporate it in individual site safety programs in accordance with applicable hazard communication standards and regulations.

THE INFORMATION CONTAINED HEREIN IS BASED ON DATA CONSIDERED TO BE ACCURATE. HOWEVER, NO WARRANTY IS EXPRESSED OR IMPLIED REGARDING THE ACCURACY OF THESE DATA OR THE RESULTS TO BE OBTAINED FROM THE USE THEREOF.

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MATERIAL SAFETY DATA SHEET

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Name: Buffer Solution, pH 2.0
Catalog Number: 45233

Hach Company
P.O.Box 389
Loveland, CO USA 80539
(970) 669-3050

Emergency Telephone Numbers:
(Medical and Transportation)
(303) 623-5716 24 Hour Service
(513)232-2533 8am - 4pm CST

MSDS Number: M00489
Chemical Name: Not applicable
CAS No.: Not applicable
Chemical Formula: Not applicable
Chemical Family: Not applicable
Hazard: Causes eye burns.
Date of MSDS Preparation:
Day: 23
Month: 09
Year: 2004

2. COMPOSITION / INFORMATION ON INGREDIENTS

Demineralized Water
CAS No.: 7732-18-5
TSCA CAS Number: 7732-18-5
Percent Range: 65.0 - 75.0
Percent Range Units: volume / volume
LD50: None reported
LC50: None reported
TLV: Not established
PEL: Not established
Hazard: No effects anticipated.

Sodium Bisulfate
CAS No.: 10034-88-5
TSCA CAS Number: 7681-38-1
Percent Range: 10.0 - 20.0
Percent Range Units: weight / volume
LD50: Oral rat LD50 = 2828 mg/kg; Oral rat LD50 = 1600 mg/kg
LC50: None reported
TLV: Not established
PEL: Not established
Hazard: Causes eye burns. Causes irritation.

Sodium Sulfate
CAS No.: 7757-82-6
TSCA CAS Number: 7757-82-6
Percent Range: 10.0 - 20.0
Percent Range Units: weight / volume
LD50: Oral mouse LD50 = 5989 mg/kg
LC50: None reported
TLV: Not established
PEL: Not established
Hazard: May cause irritation.

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Upper Explosion Limits: Not applicable
Autoignition Temperature: Not applicable
Hazardous Combustion Products: This material will not burn.
Fire / Explosion Hazards: None reported
Static Discharge: None reported.
Mechanical Impact: None reported
Extinguishing Media: Use media appropriate to surrounding fire conditions
Fire Fighting Instruction: As in any fire, wear self-contained breathing apparatus pressure-demand and full protective gear.

6. ACCIDENTAL RELEASE MEASURES

Spill Response Notice:
Only persons properly qualified to respond to an emergency involving hazardous substances may respond to a spill according to federal regulations (OSHA 29 CFR 1910.120(a)(v)) and per your company's emergency response plan and guidelines/procedures. See Section 13, Special Instructions for disposal assistance.
Containment Technique: Absorb spilled liquid with non-reactive sorbent material. Stop spilled material from being released to the environment.
Clean-up Technique: Cover spilled material with an alkali, such as soda ash or sodium bicarbonate. Scoop up slurry into a large beaker. Adjust to a pH between 6 and 9 with an alkali, such as soda ash or sodium bicarbonate. Flush reacted material to the drain with a large excess of water. Decontaminate the area of the spill with a soap solution.
Evacuation Procedure: Evacuate as needed to perform spill clean-up. If conditions warrant, increase the size of the evacuation.
Special Instructions (for accidental release): Product is regulated as RCRA hazardous waste.
304 EHS RQ (40 CFR 355): Not applicable
D.O.T. Emergency Response Guide Number: None

7. HANDLING / STORAGE

Handling: Avoid contact with eyes skin clothing Wash thoroughly after handling. Maintain general industrial hygiene practices when using this product.
Storage: Keep container tightly closed when not in use.
Flammability Class: Not applicable

8. EXPOSURE CONTROLS / PROTECTIVE EQUIPMENT

Engineering Controls: Have an eyewash station nearby. Maintain general industrial hygiene practices when using this product.
Personal Protective Equipment:
Eye Protection: safety glasses with top and side shields
Skin Protection: disposable latex gloves lab coat
Inhalation Protection: adequate ventilation
Precautionary Measures: Avoid contact with: eyes skin clothing Wash thoroughly after handling. Protect from: freezing
TLV: Not established
PEL: Not established

9. PHYSICAL / CHEMICAL PROPERTIES

Appearance: Clear, colorless liquid
Physical State: Liquid
Molecular Weight: Not applicable
Odor: None
pH: 2.0 @ 20°C
Vapor Pressure: Not determined
Vapor Density (air = 1): Not determined
Boiling Point: 100°C (212°F)
Melting Point: Not determined

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DOT Subsidiary Risk: NA
DOT ID Number: NA
DOT Packing Group: NA
I.C.A.O.:
I.C.A.O. Proper Shipping Name: Not Currently Regulated
–
ICAO Hazard Class: NA
ICAO Subsidiary Risk: NA
ICAO ID Number: NA
ICAO Packing Group: NA
I.M.O.:
I.M.O. Proper Shipping Name: Not Currently Regulated
–
I.M.O. Hazard Class: NA
I.M.O. Subsidiary Risk: NA
I.M.O. ID Number: NA
I.M.O. Packing Group: NA
Additional Information: This product may be shipped as part of a chemical kit composed of various compatible dangerous goods for analytical or testing purposes. This kit would have the following classification: Proper Shipping Name: Chemical Kit Hazard Class: 9 UN Number 3316

15. REGULATORY INFORMATION

U.S. Federal Regulations:
O.S.H.A.: This product meets the criteria for a hazardous substance as defined in the Hazard Communication Standard. (29 CFR 1910.1200)
E.P.A.:
S.A.R.A. Title III Section 311/312 Categorization (40 CFR 370): Immediate (Acute) Health Hazard
S.A.R.A. Title III Section 313 (40 CFR 372): This product does NOT contain any chemical subject to the reporting requirements of Section 313 of Title III of SARA.
–
302 (EHS) TPQ (40 CFR 355): Not applicable
304 CERCLA RQ (40 CFR 302.4): Not applicable
304 EHS RQ (40 CFR 355): Not applicable
Clean Water Act (40 CFR 116.4): Not applicable
RCRA: Contains RCRA regulated substances. See Section 13, EPA Waste ID Number.
C.P.S.C.: Not applicable
State Regulations:
California Prop. 65: No Prop. 65 listed chemicals are present in this product.
Identification of Prop. 65 Ingredient(s): None
Trade Secret Registry: Not applicable
National Inventories:
U.S. Inventory Status: All ingredients in this product are listed on the TSCA 8(b) Inventory (40 CFR 710).
TSCA CAS Number: Not applicable

16. OTHER INFORMATION

Intended Use: Buffer
References: 29 CFR 1900 - 1910 (Code of Federal Regulations - Labor). Air Contaminants, Federal Register, Vol. 54, No. 12. Thursday, January 19, 1989. pp. 2332-2983. TLV's Threshold Limit Values and Biological Exposure Indices for 1992-1993. American Conference of Governmental Industrial Hygienists, 1992. Technical Judgment. Fire Protection Guide on Hazardous Materials, 10th Ed. Quincy, MA: National Fire Protection Fire Protection Guide on Hazardous Materials, 10th Ed. Quincy, MA: National Fire Protection Association, 1991. In-house information.
Revision Summary: Updates in Section(s) 14,

Legend:

MATERIAL SAFETY DATA SHEET
HORIBA INSTRUMENTS, INC.
17671 Armstrong Avenue, Irvine, CA 92614
(949) 250-4811

REVISION DATE MAY 2003

SECTION I: MATERIAL IDENTIFICATION

IDENTITY: Potassium Phosphate Monobasic, 20%
Sodium Phosphate Dibasic 20% Quinhydrone 60%
P/N 350066, 9003003100 160-51

CHEMICAL FORMULA: KH_2PO_4 CAS# 7778-77-0
Na_2HPO_4 CAS# 7557-79-4
$C_{12}H_{10}O_4$ CAS# 106-34-7

GENERIC NAME: ORP Buffer Powder

CHEMICAL FAMILY: Salt
OTHER DESIGNATION: #160-51 (ORP buffer powder, 89 mv @ 25 C)

IN CASE OF EMERGENCY CONTACT YOUR REGIONAL PLANT MANAGER

SECTION II: HAZARDOUS INGREDIENTS

Dust stimulates eyes, nose and throat.
This product contains the following toxic chemical(s) subject to Section 313 Title III reporting requirements (40 CFR Part 372): NONE

SECTION III: PHYSICAL DATA

MELTING POINT (*): 174-300°C SPECIFIC GRAVITY (H_2O = 1): 1.636
VAPOR PRESSURE: N/A PERCENT, VOLATILE BY VOLUME (%): None
SOLUBILITY IN WATER v/v @°C: 1.2% (cool water)
APPEARANCE AND ODOR: Green crystal powder, odorless

SECTION IV: FIRE AND EXPLOSION HAZARD DATA

FLASH POINT AND METHOD: N/A
FLAMMABLE LIMITS: None
EXTINGUISHING MEDIA: Carbon Dioxide, foam, powder
SPECIAL FIRE FIGHTING PROCEDURES: None
UNUSUAL FIRE AND EXPLOSION HAZARDS: N/A

SECTION V: REACTIVITY DATA

STABILITY: Stable at normal temperature
INCOMPATIBILITY (MATERIALS TO AVOID): Strong oxidizing agents, nitric acid
HAZARDOUS DECOMPOSITION PRODUCTS: CO, CO_2, oxides of potassium, potassium fume
HAZARDOUS POLYMERIZATION: Will not occur

SECTION VI: HEALTH HAZARD DATA

EMERGENCY AND FIRST AID PROCEDURES:

Eyes: Wash eyes with clean water flowing for 10-15 minutes. Call doctor immediately.
Skin: Take off contaminated clothing and wash skin with water.
Inhaled: Move the patient into clear air. Keep patient warm and stable. Loosen clothing and use artificial respiration if necessary. Call doctor immediately.
Swallowed: Give patient plenty of warm water/milk. Induce vomiting. Call doctor immediately. If patient is unconscious, do not give water/milk, but call doctor immediately.

SECTION VII: SPILL OR LEAK PROCEDURES Highway or railway spills call Chemtrec (800) 424-9300

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED: Collect as much material as possible. The place of leakage should be washed with plenty of water.
WASTE DISPOSAL METHOD:
Mix solid waste with combustible materials and put into the incinerator (which has a scrubber).

SECTION VIII: SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION (SPECIFY TYPE): Not normally required.
VENTILATION: Not normally required.
OTHER PROTECTIVE EQUIPMENT: Optional - dust-proof mask, eye mask, gloves and long-sleeve working clothes.

SECTION IX: SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING:
Restrain dust while working. After working, gargle and wash hands thoroughly.
OTHER PRECAUTIONS: None.

* Information herein is given in good faith, but no warranty, expressed or implied, is made.

World Headquarters
Hach Company
P.O.Box 389
Loveland, CO USA 80539
(970) 669-3050

MATERIAL SAFETY DATA SHEET

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Name: Buffer Solution pH 4.01 ± 0.01
Catalog Number: 2283449

Hach Company
P.O.Box 389
Loveland, CO USA 80539
(970) 669-3050

Emergency Telephone Numbers:
(Medical and Transportation)
(303) 623-5716 24 Hour Service
(515)232-2533 8am - 4pm CST

MSDS Number: M00368
Chemical Name: Not applicable
CAS No.: Not applicable
Chemical Formula: Not applicable
Chemical Family: Not applicable
Hazard: Practically non-toxic.
Date of MSDS Preparation:
Day: 23
Month: 09
Year: 2004

2. COMPOSITION / INFORMATION ON INGREDIENTS

Demineralized Water
CAS No.: 7732-18-5
TSCA CAS Number: 7732-18-5
Percent Range: >95.0
Percent Range Units: weight / weight
LD50: None reported
LC50: None reported
TLV: Not established
PEL: Not established
Hazard: No effects anticipated.

Other components, each
CAS No.: Not applicable
TSCA CAS Number: Not applicable
Percent Range: < 1.0
Percent Range Units: volume / volume
LD50: Not applicable
LC50: Not applicable
TLV: Not established
PEL: Not established
Hazard: Any ingredient(s) of this product listed as "Other component(s)" is not considered a health hazard to the user of this product.

Potassium Acid Phthalate
CAS No.: 877-24-7
TSCA CAS Number: 877-24-7
Percent Range: 1.0 - 5.0
Percent Range Units: weight / volume
LD50: Oral rat LDLo = 3200 mg/kg
LC50: None reported
TLV: Not established
PEL: Not established
Hazard: May cause irritation.

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(970) 669-3050

Hazardous Combustion Products: Not applicable
Fire / Explosion Hazards: None reported
Static Discharge: None reported.
Mechanical Impact: None reported
Extinguishing Media: Use media appropriate to surrounding fire conditions
Fire Fighting Instruction: As in any fire, wear self-contained breathing apparatus pressure-demand and full protective gear.

6. ACCIDENTAL RELEASE MEASURES

Spill Response Notice:
Only persons properly qualified to respond to an emergency involving hazardous substances may respond to a spill according to federal regulations (OSHA 29 CFR 1910.120(a)(v)) and per your company's emergency response plan and guidelines/procedures. See Section 13, Special Instructions for disposal assistance.
Containment Technique: Stop spilled material from being released to the environment.
Clean-up Technique: Cover spilled material with an alkali, such as soda ash or sodium bicarbonate. Scoop up slurry into a large beaker. Adjust to a pH between 6 and 9 with an alkali, such as soda ash or sodium bicarbonate. Flush reacted material to the drain with a large excess of water. Decontaminate the area of the spill with a soap solution.
Evacuation Procedure: Evacuate as needed to perform spill clean-up. If conditions warrant, increase the size of the evacuation.
Special Instructions (for accidental release): Not applicable
304 EHS RQ (40 CFR 355): Not applicable
D.O.T. Emergency Response Guide Number: None

7. HANDLING / STORAGE

Handling: Avoid contact with eyes Wash thoroughly after handling.
Storage: Keep container tightly closed when not in use.
Flammability Class: Not applicable

8. EXPOSURE CONTROLS / PROTECTIVE EQUIPMENT

Engineering Controls: Maintain general industrial hygiene practices when using this product.
Personal Protective Equipment:
Eye Protection: safety glasses with top and side shields
Skin Protection: disposable latex gloves
Inhalation Protection: adequate ventilation
Precautionary Measures: Avoid contact with: eyes Wash thoroughly after handling.
TLV: Not established
PEL: Not established

9. PHYSICAL / CHEMICAL PROPERTIES

Appearance: Clear, red liquid
Physical State: Liquid
Molecular Weight: Not applicable
Odor: None
pH: 4.01
Vapor Pressure: Not determined
Vapor Density (air = 1): Not determined
Boiling Point: > 100°C (> 212°F)
Melting Point: < 0°C (< 32°F)
Specific Gravity (water = 1): 1.002
Evaporation Rate (water = 1): Not determined
Volatile Organic Compounds Content: Not applicable
Partition Coefficient (n-octanol / water): Not determined
Solubility:
Water: Soluble

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ICAO Packing Group: NA
I.M.O.:
I.M.O. Proper Shipping Name: Not Currently Regulated
--
I.M.O. Hazard Class: NA
I.M.O. Subsidiary Risk: NA
I.M.O. ID Number: NA
I.M.O. Packing Group: NA
Additional Information: This product may be shipped as part of a chemical kit composed of various compatible dangerous goods for analytical or testing purposes. This kit would have the following classification: Proper Shipping Name: Chemical Kit Hazard Class: 9 UN Number 3316

15. REGULATORY INFORMATION

U.S. Federal Regulations:
O.S.H.A.: This product does not meet the criteria for a hazardous substance as defined in the Hazard Communication Standard. (29 CFR 1910.1200)
E.P.A.:
S.A.R.A. Title III Section 311/312 Categorization (40 CFR 370): This product is not hazardous under 29 CFR 1910.1200 and therefore is not covered by Title III under SARA.
S.A.R.A. Title III Section 313 (40 CFR 372): This product does NOT contain any chemical subject to the reporting requirements of Section 313 of Title III of SARA.
--
302 (EHS) TPQ (40 CFR 355): Not applicable
304 CERCLA RQ (40 CFR 302.4): Not applicable
304 EHS RQ (40 CFR 355): Not applicable
Clean Water Act (40 CFR 116.4): Not applicable
RCRA: Contains no RCRA regulated substances.
C.P.S.C.: Not applicable
State Regulations:
California Prop. 65: No Prop. 65 listed chemicals are present in this product.
Identification of Prop. 65 Ingredient(s): --
Trade Secret Registry: Not applicable
National Inventories:
U.S. Inventory Status: All ingredients in this product are listed on the TSCA 8(b) Inventory (40 CFR 710).
TSCA CAS Number: Not applicable

16. OTHER INFORMATION

Intended Use: Buffer
References: 29 CFR 1900 - 1910 (Code of Federal Regulations - Labor). Air Contaminants, Federal Register, Vol. 54, No. 12, Thursday, January 19, 1989. pp. 2332-2983. TLV's Threshold Limit Values and Biological Exposure Indices for 1992-1993. American Conference of Governmental Industrial Hygienists, 1992. Technical Judgment. In-house information. Fire Protection Guide on Hazardous Materials, 10th Ed. Quincy, MA: National Fire Protection Fire Protection Guide on Hazardous Materials, 10th Ed. Quincy, MA: National Fire Protection Association, 1991.
Revision Summary: Updates in Section(s) 14.

Legend:

NA - Not Applicable	w/w - weight/weight
ND - Not Determined	w/v - weight/volume
NV - Not Available	v/v - volume/volume

USER RESPONSIBILITY: Each user should read and understand this information and incorporate it in individual site safety programs in accordance with applicable hazard communication standards and regulations.

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MATERIAL SAFETY DATA SHEET

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Name: Buffer Solution pH 7.00 ± 0.02
Catalog Number: 2283549

Hach Company
P.O.Box 389
Loveland, CO USA 80539
(970) 669-3050

Emergency Telephone Numbers:
(Medical and Transportation)
(303) 623-5716 24 Hour Service
(515)232-2533 8am - 4pm CST

MSDS Number: M00369
Chemical Name: Not applicable
CAS No.: Not applicable
Chemical Formula: Not applicable
Chemical Family: Not applicable
Hazard: Practically non-toxic.
Date of MSDS Preparation:
Day: 23
Month: 09
Year: 2004

2. COMPOSITION / INFORMATION ON INGREDIENTS

Demineralized Water
CAS No.: 7732-18-5
TSCA CAS Number: 7732-18-5
Percent Range: >95.0
Percent Range Units: volume / volume
LD50: None reported
LC50: None reported
TLV: Not established
PEL: Not established
Hazard: No effects anticipated.

Other components, each
CAS No.: Not applicable
TSCA CAS Number: Not applicable
Percent Range: < 1.0
Percent Range Units: volume / volume
LD50: Not applicable
LC50: Not applicable
TLV: Not established
PEL: Not established
Hazard: Any ingredient(s) of this product listed as "Other component(s)" is not considered a health hazard to the user of this product.

3. HAZARDS IDENTIFICATION

Emergency Overview:
Appearance: Clear, yellow liquid
Odor: None

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Spill Response Notice:
Only persons properly qualified to respond to an emergency involving hazardous substances may respond to a spill according to federal regulations (OSHA 29 CFR 1910.120(a)(v)) and per your company's emergency response plan and guidelines/procedures. See Section 13, Special Instructions for disposal assistance.
Containment Technique: Stop spilled material from being released to the environment.
Clean-up Technique: Absorb spilled liquid with non-reactive sorbent material. Place material in a plastic bag. Mark bag 'Non-hazardous trash', and dispose of as normal refuse.
Evacuation Procedure: Evacuate as needed to perform spill clean-up. If conditions warrant, increase the size of the evacuation.
Special Instructions (for accidental release): Not applicable
304 EHS RQ (40 CFR 355): Not applicable
D.O.T. Emergency Response Guide Number: None

7. HANDLING / STORAGE

Handling: Avoid contact with eyes Wash thoroughly after handling.
Storage: Protect from: heat Keep container tightly closed when not in use.
Flammability Class: Not applicable

8. EXPOSURE CONTROLS / PROTECTIVE EQUIPMENT

Engineering Controls: Maintain general industrial hygiene practices when using this product.
Personal Protective Equipment:
Eye Protection: safety glasses with top and side shields
Skin Protection: Not applicable
Inhalation Protection: adequate ventilation
Precautionary Measures: Avoid contact with: eyes Wash thoroughly after handling.
TLV: Not established
PEL: Not established

9. PHYSICAL / CHEMICAL PROPERTIES

Appearance: Clear, yellow liquid
Physical State: Liquid
Molecular Weight: Not applicable
Odor: None
pH: 7.0 at 20°C
Vapor Pressure: Not determined
Vapor Density (air = 1): Not determined
Boiling Point: ~100°C (~212°F)
Melting Point: ~0°C (~32°F)
Specific Gravity (water = 1): ~1.0
Evaporation Rate (water = 1): Not determined
Volatile Organic Compounds Content: Not applicable
Partition Coefficient (n-octanol / water): Not determined
Solubility:
Water: Soluble
Acid: Soluble
Other: Not determined
Metal Corrosivity:
Steel: Not determined
Aluminum: Not determined

10. STABILITY / REACTIVITY

Chemical Stability: Stable when stored under proper conditions.
Conditions to Avoid: Heat Evaporation
Reactivity / Incompatibility: None reported

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P.O.Box 389
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(970) 669-3050

15. REGULATORY INFORMATION

U.S. Federal Regulations:

O.S.H.A.: This product does not meet the criteria for a hazardous substance as defined in the Hazard Communication Standard. (29 CFR 1910.1200)

E.P.A.:

S.A.R.A. Title III Section 311/312 Categorization (40 CFR 370): This product is not hazardous under 29 CFR.1910.1200 and therefore is not covered by Title III under SARA.

S.A.R.A. Title III Section 313 (40 CFR 372): This product does NOT contain any chemical subject to the reporting requirements of Section 313 of Title III of SARA.

302 (EHS) TPQ (40 CFR 355): Not applicable

304 CERCLA RQ (40 CFR 302.4): Not applicable

304 EHS RQ (40 CFR 355): Not applicable

Clean Water Act (40 CFR 116.4): Not applicable

RCRA: Contains no RCRA regulated substances.

C.P.S.C.: Not applicable

State Regulations:

California Prop. 65: No Prop. 65 listed chemicals are present in this product.

Identification of Prop. 65 Ingredient(s): None

Trade Secret Registry: Not applicable

National Inventories:

U.S. Inventory Status: All ingredients in this product are listed on the TSCA 8(b) Inventory (40 CFR 710).

TSCA CAS Number: Not applicable

16. OTHER INFORMATION

Intended Use: Buffer

References: 29 CFR 1900 - 1910 (Code of Federal Regulations - Labor). Air Contaminants, Federal Register, Vol. 54, No. 12. Thursday, January 19, 1989. pp. 2332-2983. TLV's Threshold Limit Values and Biological Exposure Indices for 1992-1993. American Conference of Governmental Industrial Hygienists, 1992. Technical Judgment. In-house information.

Revision Summary: Updates in Section(s) 14,

Legend:

NA - Not Applicable	w/w - weight/weight
ND - Not Determined	w/v - weight/volume
NV - Not Available	v/v - volume/volume

USER RESPONSIBILITY: Each user should read and understand this information and incorporate it in individual site safety programs in accordance with applicable hazard communication standards and regulations.

THE INFORMATION CONTAINED HEREIN IS BASED ON DATA CONSIDERED TO BE ACCURATE. HOWEVER, NO WARRANTY IS EXPRESSED OR IMPLIED REGARDING THE ACCURACY OF THESE DATA OR THE RESULTS TO BE OBTAINED FROM THE USE THEREOF.

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Hach Company
P.O.Box 389
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MATERIAL SAFETY DATA SHEET

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Name: Potassium Chloride Reference Electrolyte Cartridge
Catalog Number: 2546902

Hach Company
P.O.Box 389
Loveland, CO USA 80539
(970) 669-3050

Emergency Telephone Numbers:
(Medical and Transportation)
(303) 623-5716 24 Hour Service
(515)232-2533 8am - 4pm CST

MSDS Number: M00865
Chemical Name: Not applicable
CAS No.: Not applicable
Chemical Formula: Not applicable
Chemical Family: Not applicable
Hazard: May cause irritation.
Date of MSDS Preparation:
Day: 23
Month: 09
Year: 2004

2. COMPOSITION / INFORMATION ON INGREDIENTS

Glycerin
CAS No.: 56-81-5
TSCA CAS Number: 56-81-5
Percent Range: 35.0 - 45.0
Percent Range Units: volume / volume
LD50: Oral rat LD50 = 12.6 g/kg
LC50: None reported
TLV: 10 mg/m^3 (mist)
PEL: 10 mg/m^3 (mist)
Hazard: May cause eye irritation.

Hydroxyethyl Cellulose
CAS No.: 9004-62-0
TSCA CAS Number: 9004-62-0
Percent Range: 1.0 - 5.0
Percent Range Units: weight / volume
LD50: None reported
LC50: None reported
TLV: None established
PEL: None established
Hazard: May cause irritation.

Ethylmercurithiosalicylic acid, sodium salt
CAS No.: 54-64-8 Contains Mercury, Dispose Per Local, State or Federal Laws.
TSCA CAS Number: 54-64-8
Percent Range: < 1.0
Percent Range Units: weight / weight
LD50: Oral rat LD_{50} = 75 mg/kg; Oral mouse LD_{50} = 91 mg/kg.
LC50: None reported
TLV: 0.1 mg(Hg)/m^3 (skin)
PEL: 0.1 mg(Hg)/m^3 (skin)
Hazard: Toxic. May cause irritation. Cumulative poison. Experimental mutagen. Experimental teratogen. May be embryotoxic.

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Reactivity: 0
Protective Equipment: X - See protective equipment, Section 8.
NFPA:
Health: 1
Flammability: 1
Reactivity: 0
Symbol: Not applicable
Potential Health Effects:
Eye Contact: May cause irritation
Skin Contact: May cause irritation
Skin Absorption: No effects anticipated
Target Organs: Not applicable
Ingestion: May cause: gastrointestinal irritation nausea vomiting diarrhea muscular weakness blood pressure changes fever cardiac depression
Target Organs: Blood Heart
Inhalation: No effects anticipated
Target Organs: Not applicable
Medical Conditions Aggravated: Pre-existing: Kidney conditions Liver conditions
Chronic Effects: Chronic overexposure may cause kidney damage
Cancer / Reproductive Toxicity Information:
This product does NOT contain any OSHA listed carcinogens.

This product does NOT contain any IARC listed chemicals.

This product does NOT contain any NTP listed chemicals.

Additional Cancer / Reproductive Toxicity Information: None reported
Toxicologically Synergistic Products: None reported

4. FIRST AID

Eye Contact: Flush eyes with water. Call physician if irritation develops.
Skin Contact (First Aid): Wash skin with plenty of water for 15 minutes.
Ingestion (First Aid): Give large quantities of water. Call physician immediately.
Inhalation: None required.

5. FIRE FIGHTING MEASURES

Flammable Properties: During a fire, corrosive and toxic gases may be generated by thermal decomposition.
Flash Point: Not applicable
Method: Not applicable
Flammability Limits:
Lower Explosion Limits: Not applicable
Upper Explosion Limits: Not applicable
Autoignition Temperature: Not determined
Hazardous Combustion Products: None reported
Fire / Explosion Hazards: None reported
Static Discharge: None reported.
Mechanical Impact: None reported
Extinguishing Media: Use media appropriate to surrounding fire conditions
Fire Fighting Instruction: As in any fire, wear self-contained breathing apparatus pressure-demand and full protective gear. Evacuate area and fight fire from a safe distance.

6. ACCIDENTAL RELEASE MEASURES

Spill Response Notice:

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Hach Company
P.O.Box 389
Loveland, CO USA 80539
(970) 669-3050

Reactivity / Incompatibility: Incompatible with: oxidizers chromates perchlorates
Hazardous Decomposition: Heating to decomposition releases toxic and/or corrosive fumes of: acrolein carbon dioxide carbon monoxide chlorides
Hazardous Polymerization: Will not occur.

11. TOXICOLOGICAL INFORMATION

Product Toxicological Data:
LD50: None reported
LC50: None reported
Dermal Toxicity Data: None reported
Skin and Eye Irritation Data: Potassium Chloride: Eye rabbit: 500 mg/24H - MILD
Mutation Data: Glycerin: Sister chromatid exchange - human lymphocyte - 100 mg/l
Reproductive Effects Data: None reported
Ingredient Toxicological Data: Potassium Chloride: Oral rat LD50 = 2600 mg/kg, Oral man LDLo = 20 mg/kg; Glycerin: Oral rat LD50 = 7930 mg/kg

12. ECOLOGICAL INFORMATION

Product Ecological Information: --
No ecological data available for this product.
Ingredient Ecological Information: –
No ecological data available for the ingredients of this product.

13. DISPOSAL CONSIDERATIONS

EPA Waste ID Number: D009, D011
Special Instructions (Disposal): Dispose of material in an E.P.A. approved hazardous waste facility.
Empty Containers: Rinse three times with an appropriate solvent. Dispose of empty container as normal trash. Rinsate from empty containers may contain sufficient product to require disposal as hazardous waste.
NOTICE (Disposal): These disposal guidelines are based on federal regulations and may be superseded by more stringent state or local requirements. Please consult your local environmental regulators for more information.

14. TRANSPORT INFORMATION

D.O.T.:
D.O.T. Proper Shipping Name: Not Currently Regulated
–
DOT Hazard Class: NA
DOT Subsidiary Risk: NA
DOT ID Number: NA
DOT Packing Group: NA
I.C.A.O.:
I.C.A.O. Proper Shipping Name: Not Currently Regulated
–
ICAO Hazard Class: NA
ICAO Subsidiary Risk: NA
ICAO ID Number: NA
ICAO Packing Group: NA
I.M.O.:
I.M.O. Proper Shipping Name: Not Currently Regulated
–
I.M.O. Hazard Class: NA
I.M.O. Subsidiary Risk: NA
I.M.O. ID Number: NA
I.M.O. Packing Group: NA

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Hach Company
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MATERIAL SAFETY DATA SHEET

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Name: Dissolved Oxygen Electrode Filling Solution
Catalog Number: 2759126

Hach Company
P.O.Box 389
Loveland, CO USA 80539
(970) 669-3050

Emergency Telephone Numbers:
(Medical and Transportation)
(303) 623-5716 24 Hour Service
(515)232-2533 8am - 4pm CST

MSDS Number: M01669
Chemical Name: Not applicable
CAS No.: Not applicable
Chemical Formula: Not applicable
Chemical Family: Not applicable
Hazard: May cause irritation.
Date of MSDS Preparation:
Day: 24
Month: 09
Year: 2004

2. COMPOSITION / INFORMATION ON INGREDIENTS

Glycerin
CAS No.: 56-81-5
TSCA CAS Number: 56-81-5
Percent Range: 20.0 - 30.0
Percent Range Units: weight / weight
LD50: Oral rat LD50 = 12.6 g/kg
LC50: None reported
TLV: 10 mg/m^3 (mist)
PEL: 10 mg/m^3 (mist)
Hazard: May cause eye irritation.

Demineralized Water
CAS No.: 7732-18-5
TSCA CAS Number: 7732-18-5
Percent Range: 70.0 - 80.0
Percent Range Units: weight / weight
LD50: None reported
LC50: None reported
TLV: Not established
PEL: Not established
Hazard: No effects anticipated.

Other component
CAS No.: Not applicable
TSCA CAS Number: Not applicable
Percent Range: < 1.0
Percent Range Units: weight / weight
LD50: Not applicable
LC50: Not applicable
TLV: Not established
PEL: Not established
Hazard: Any ingredient(s) of this product listed as "Other component(s)" is not considered a health hazard to the user of this product.

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P.O.Box 389
Loveland, CO USA 80539
(970) 669-3050

Inhalation: None required.

5. FIRE FIGHTING MEASURES

Flammable Properties: During a fire, corrosive and toxic gases may be generated by thermal decomposition. Material will not burn.
Flash Point: Not applicable
Method: Not applicable
Flammability Limits:
Lower Explosion Limits: Not applicable
Upper Explosion Limits: Not applicable
Autoignition Temperature: Not applicable
Hazardous Combustion Products: This material will not burn.
Fire / Explosion Hazards: None reported
Static Discharge: None reported.
Mechanical Impact: None reported
Extinguishing Media: Use media appropriate to surrounding fire conditions
Fire Fighting Instruction: As in any fire, wear self-contained breathing apparatus pressure-demand and full protective gear. Evacuate area and fight fire from a safe distance.

6. ACCIDENTAL RELEASE MEASURES

Spill Response Notice:
Only persons properly qualified to respond to an emergency involving hazardous substances may respond to a spill according to federal regulations (OSHA 29 CFR 1910.120(a)(v)) and per your company's emergency response plan and guidelines/procedures. See Section 13, Special Instructions for disposal assistance.
Containment Technique: Absorb spilled liquid with non-reactive sorbent material. Dike large spills to keep spilled material from entering sewage and drainage systems or bodies of water.
Clean-up Technique: Absorb spilled liquid with non-reactive sorbent material. Sweep up material. Place material in a plastic bag. Mark bag 'Non-hazardous trash', and dispose of as normal refuse. Decontaminate the area of the spill with a soap solution.
Evacuation Procedure: Evacuate as needed to perform spill clean-up. If conditions warrant, increase the size of the evacuation.
Special Instructions (for accidental release): Not applicable
304 EHS RQ (40 CFR 355): Not applicable
D.O.T. Emergency Response Guide Number: Not applicable

7. HANDLING / STORAGE

Handling: Avoid contact with eyes skin Wash thoroughly after handling. Maintain general industrial hygiene practices when using this product.
Storage: Store between 10° and 25°C. Keep away from: oxidizers
Flammability Class: Not applicable

8. EXPOSURE CONTROLS / PROTECTIVE EQUIPMENT

Engineering Controls: Have an eyewash station nearby. Maintain general industrial hygiene practices when using this product.
Personal Protective Equipment:
Eye Protection: safety glasses with top and side shields
Skin Protection: disposable latex gloves
Inhalation Protection: adequate ventilation
Precautionary Measures: Avoid contact with: eyes skin Wash thoroughly after handling. Keep away from: oxidizers
TLV: Not established
PEL: Not established

9. PHYSICAL / CHEMICAL PROPERTIES

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(970) 669-3050

Empty Containers: Rinse three times with an appropriate solvent. Dispose of empty container as normal trash.
NOTICE (Disposal): These disposal guidelines are based on federal regulations and may be superseded by more stringent state or local requirements. Please consult your local environmental regulators for more information.

14. TRANSPORT INFORMATION

D.O.T.:
D.O.T. Proper Shipping Name: Not Currently Regulated
--
DOT Hazard Class: NA
DOT Subsidiary Risk: NA
DOT ID Number: NA
DOT Packing Group: NA
I.C.A.O.:
I.C.A.O. Proper Shipping Name: Not Currently Regulated
--
ICAO Hazard Class: NA
ICAO Subsidiary Risk: NA
ICAO ID Number: NA
ICAO Packing Group: NA
I.M.O.:
I.M.O. Proper Shipping Name: Not Currently Regulated
--
I.M.O. Hazard Class: NA
I.M.O. Subsidiary Risk: NA
I.M.O. ID Number: NA
I.M.O. Packing Group: NA
Additional Information: This product may be shipped as part of a chemical kit composed of various compatible dangerous goods for analytical or testing purposes. This kit would have the following classification: Proper Shipping Name: Chemical Kit Hazard Class: 9 UN Number 3316

15. REGULATORY INFORMATION

U.S. Federal Regulations:
O.S.H.A.: This product meets the criteria for a hazardous substance as defined in the Hazard Communication Standard. (29 CFR 1910.1200)
E.P.A.:
S.A.R.A. Title III Section 311/312 Categorization (40 CFR 370): Immediate (Acute) Health Hazard
S.A.R.A. Title III Section 313 (40 CFR 372): This product does NOT contain any chemical subject to the reporting requirements of Section 313 of Title III of SARA.
--
302 (EHS) TPQ (40 CFR 355): Not applicable
304 CERCLA RQ (40 CFR 302.4): Not applicable
304 EHS RQ (40 CFR 355): Not applicable
Clean Water Act (40 CFR 116.4): Not applicable
RCRA: Contains no RCRA regulated substances.
C.P.S.C.: Not applicable
State Regulations:
California Prop. 65: No Prop. 65 listed chemicals are present in this product.
Identification of Prop. 65 Ingredient(s): --
Trade Secret Registry: Not applicable
National Inventories:
U.S. Inventory Status: All ingredients in this product are listed on the TSCA 8(b) Inventory (40 CFR 710).
TSCA CAS Number: Not applicable

16. OTHER INFORMATION

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Loveland, CO USA 80539
(970) 669-3050

MATERIAL SAFETY DATA SHEET

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Name: TOC Persulfate
Catalog Number: 2790166

Hach Company
P.O.Box 389
Loveland, CO USA 80539
(970) 669-3050

Emergency Telephone Numbers:
(Medical and Transportation)
(303) 623-5716 24 Hour Service
(515)232-2533 8am - 4pm CST

MSDS Number: M00039
Chemical Name: Peroxydisulfuric Acid, Dipotassium Salt
CAS No.: 7727-21-1
Chemical Formula: $K_2S_2O_8$
Chemical Family: Oxidizing Agents
Hazard: Causes severe eye irritation. Oxidizer. Allergen
Date of MSDS Preparation:
Day: 22
Month: 09
Year: 2004

2. COMPOSITION / INFORMATION ON INGREDIENTS

Potassium Persulfate
CAS No.: 7727-21-1
TSCA CAS Number: 7727-21-1
Percent Range: 100.0
Percent Range Units: weight / weight
LD50: Oral Rat LD50 = 802 mg/kg
LC50: None reported
TLV: 5 mg/m^3
PEL: Not established
Hazard: Causes severe eye irritation. Oxidizer. Allergen

3. HAZARDS IDENTIFICATION

Emergency Overview:
Appearance: White to light yellow crystals
Odor: None
CAUSES EYE AND RESPIRATORY TRACT IRRITATION
MAY CAUSE ALLERGIC SKIN AND RESPIRATORY REACTIONS
STRONG OXIDIZER: CONTACT WITH OTHER MATERIAL MAY CAUSE FIRE

HMIS:
Health: 2
Flammability: 0
Reactivity: 0
Protective Equipment: X - See protective equipment, Section 8.
NFPA:
Health: 1
Flammability: 0
Reactivity: 0
Symbol: oxy
Potential Health Effects:

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Evacuation Procedure: Evacuate local area (15 foot radius or as directed by your facility's emergency response plan) when: a pound or more of loose powder is spilled. If conditions warrant, increase the size of the evacuation.
Special Instructions (for accidental release): Mixture contains a component which is regulated as hazardous waste.
304 EHS RQ (40 CFR 355): Not applicable
D.O.T. Emergency Response Guide Number: 140

7. HANDLING / STORAGE

Handling: Avoid contact with eyes skin Do not breathe dust. Wash thoroughly after handling. Maintain general industrial hygiene practices when using this product.
Storage: Keep away from: reducers oxidizable materials Protect from: moisture heat
Flammability Class: Not applicable

8. EXPOSURE CONTROLS / PROTECTIVE EQUIPMENT

Engineering Controls: Have an eyewash station nearby. Use a fume hood to avoid exposure to dust, mist or vapor.
Personal Protective Equipment:
Eye Protection: safety glasses with top and side shields
Skin Protection: lab coat disposable latex gloves
Inhalation Protection: laboratory fume hood
Precautionary Measures: Avoid contact with: eyes skin Do not breathe: dust Wash thoroughly after handling. Keep away from: oxidizable materials reducers
TLV: 5 mg/m^3
PEL: Not established

9. PHYSICAL / CHEMICAL PROPERTIES

Appearance: White to light yellow crystals
Physical State: Solid
Molecular Weight: 270.32
Odor: None
pH: of 5% solution = 4.1
Vapor Pressure: Not applicable
Vapor Density (air = 1): Not applicable
Boiling Point: Not applicable
Melting Point: Decomposes at >100°C or 212°F
Specific Gravity (water = 1): 2.477
Evaporation Rate (water = 1): Not applicable
Volatile Organic Compounds Content: 0.0%
Partition Coefficient (n-octanol / water): Not determined
Solubility:
Water: Soluble
Acid: Not determined
Other: Not determined
Metal Corrosivity:
Steel: 0.704 in/yr
Aluminum: 0.137 in/yr

10. STABILITY / REACTIVITY

Chemical Stability: Stable when stored under proper conditions.
Conditions to Avoid: Excess moisture Exposure to air. Heating to decomposition.
Reactivity / Incompatibility: May react violently in contact with: oxidizable material reducers
Hazardous Decomposition: Heating to decomposition releases toxic and/or corrosive fumes of: sulfur oxides
Hazardous Polymerization: Will not occur.

11. TOXICOLOGICAL INFORMATION

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Hach Company
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Loveland, CO USA 80539
(970) 669-3050

O.S.H.A.: This product meets the criteria for a hazardous substance as defined in the Hazard Communication Standard. (29 CFR 1910.1200)
E.P.A.:
S.A.R.A. Title III Section 311/312 Categorization (40 CFR 370): Immediate (Acute) Health Hazard Delayed (Chronic) Health Hazard Fire Hazard
S.A.R.A. Title III Section 313 (40 CFR 372): This product does NOT contain any chemical subject to the reporting requirements of Section 313 of Title III of SARA.

302 (EHS) TPQ (40 CFR 355): Not applicable
304 CERCLA RQ (40 CFR 302.4): Not applicable
304 EHS RQ (40 CFR 355): Not applicable
Clean Water Act (40 CFR 116.4): Not applicable
RCRA: Contains RCRA regulated substances. See Section 13, EPA Waste ID Number.
C.P.S.C.: Not applicable
State Regulations:
California Prop. 65: No Prop. 65 listed chemicals are present in this product.
Identification of Prop. 65 Ingredient(s): Not applicable
Trade Secret Registry: Not applicable
National Inventories:
U.S. Inventory Status: TSCA Listed: Yes
TSCA CAS Number: 7727-21-1

16. OTHER INFORMATION

Intended Use: Laboratory Reagent
References: TLV's Threshold Limit Values and Biological Exposure Indices for 1992-1993. American Conference of Governmental Industrial Hygienists, 1992. The Merck Index, 11th Ed. Rahway, New Jersey: Merck and Co., Inc., 1989. Technical Judgment. Sax, N. Irving. Dangerous Properties of Industrial Materials, 7th Ed. New York: Van Nostrand Reinhold Co., 1989. List of Dangerous Substances Classified in Annex I of the EEC Directive (67/548) - Classification, Packaging and Labeling of Dangerous Substances, Amended July 1992. In-house information. Fire Protection Guide on Hazardous Materials, 10th Ed. Quincy, MA: National Fire Protection Fire Protection Guide on Hazardous Materials, 10th Ed. Quincy, MA: National Fire Protection Association, 1991. CCINFO RTECS. Canadian Centre for Occupational Health and Safety. Hamilton, Ontario Canada: 30 June 1993. CCINFO MSDS/FTSS. Canadian Centre for Occupational Health and Safety. Hamilton, Ontario Canada: 30 June 1993. Air Contaminants, Federal Register, Vol. 54, No. 12. Thursday, January 19, 1989. pp. 2332-2983. 29 CFR 1900 - 1910 (Code of Federal Regulations - Labor).
Revision Summary: Updates in Section(s) 14,

Legend:

NA - Not Applicable	w/w - weight/weight
ND - Not Determined	w/v - weight/volume
NV - Not Available	v/v - volume/volume

USER RESPONSIBILITY: Each user should read and understand this information and incorporate it in individual site safety programs in accordance with applicable hazard communication standards and regulations.

THE INFORMATION CONTAINED HEREIN IS BASED ON DATA CONSIDERED TO BE ACCURATE. HOWEVER, NO WARRANTY IS EXPRESSED OR IMPLIED REGARDING THE ACCURACY OF THESE DATA OR THE RESULTS TO BE OBTAINED FROM THE USE THEREOF.

HACH COMPANY ©2004

THATCHER COMPANY MATERIAL SAFETY DATA SHEET
PRODUCT: UREA-DAP BLEND, 39%

MSDS Date: December 17, 2003
Emergency Contact: 1-800-424-9300

SECTION I

PRODUCT NAME: Urea/DAP Blend 39%
CHEMICAL NAME: Urea & Diammonium Phosphate Solution
CHEMICAL FAMILY: Solution

DOT SHIPPING INFORMATION: Not DOT regulated.

SECTION II - HAZARDOUS INGREDIENTS

This material contains no ingredients which are known by Thatcher Company to be hazardous unless listed below.

HAZARDOUS MATERIAL	CAS NUMBER	w/w %	EXPOSURE LIMITS IN AIR

The specific identity of some ingredients may be withheld for confidential business purposes. However, all known potential health effects from exposure to these ingredients are being addressed.

SECTION III - PHYSICAL DATA

BOILING POINT (F): Unknown

SPECIFIC GRAVITY: 1.152 @ 25°C

VAPOR PRESSURE (mm Hg): Unknown

% VOLATILE, BY VOLUME: About 60%

VAPOR DENSITY (air = 1): Unknown

EVAPORATION RATE: Unknown

SOLUBILITY IN WATER: Complete

APPEARANCE: colorless, hazy liquid.

SECTION IV - FIRE AND EXPLOSION DATA

FLASH POINT: Nonflammable

FLAMMABLE LIMITS: Lel: N/A Uel: N/A

EXTINGUISHING MEDIA: Use any.

SPECIAL FIRE-FIGHTING PROCEDURES: None

UNUSUAL FIRE AND EXPLOSION HAZARDS: None

THATCHER COMPANY MATERIAL SAFETY DATA SHEET
PRODUCT: UREA-DAP BLEND, 28%

SECTION V - REACTIVITY DATA

STABILITY: Stable

HAZARDOUS POLYMERIZATION: Will not occur

CONDITIONS OR MATERIALS TO AVOID: Extreme temperatures, Nitric acid, sulfuric, perchloric, strong oxidizers, acids and alkalies.

HAZARDOUS DECOMPOSITION PRODUCTS: Ammonia, cyanuric acid, carbon dioxide, nitrogen oxides.

SECTION VI - HEALTH HAZARD DATA

Carcinogenic Listing:

NTP: No ingredients listed in this section.

IARC MONOGRAPHS: No ingredients listed in this section.

OSHA 29 CFR 1910: No ingredients listed in this section.

ENTRY ROUTES & EFFECTS OF OVEREXPOSURE:

Eye Contact: Can cause eye irritation and frontal burns.

Skin Contact: Frequent or prolonged contact may cause reddening of the skin and possibly promote an allergic irritation.

Ingestion: Abdominal pain, nausea, vomiting and gastrointestinal irritation may result.

CHRONIC: Prolonged and repeated skin contact may cause dermatitis.

STATEMENT OF PRACTICAL TREATMENT:

Eye Contact: Immediately flush with large amounts of water for at least 15 minutes, including under the eyelids. Contact a physician immediately, preferably an Ophthalmologist. Speed and thoroughness in rinsing eyes are important to avoid permanent injury.

Skin Contact: Immediately remove contaminated clothing and shoes. Wash affected areas with soap and flush with large amounts of water for 15 to 20 minutes. Get medical attention.

Ingestion: Do not induce vomiting. Get immediate medical attention.

SECTION VII - SPECIAL PRECAUTIONS

HANDLING AND STORAGE PRECAUTIONS:
Store away from incompatible material or sources of heat and ignition. Empty containers may contain residue and can be dangerous.

STEPS TO BE TAKEN IF MATERIAL SPILLS OR LEAKS:
Contain spills and allow to solidify. Shovel spilled material into containers for disposal. Wear approved respirator with ammonia cartridge or self contained breathing apparatus (SCAB). Vegetated areas should be thoroughly flushed with water.

WASTE DISPOSAL METHOD:
Dispose through a licensed waste disposal company. Follow federal, state and local regulation.

SECTION VIII - SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION:
MSA or NIOSH-approved respirator with ammonia cartridge, if necessary.

VENTILATION:
Local exhaust recommended.

EYE PROTECTION:
Chemical type safety glasses.

SKIN PROTECTION:
Rubber gloves.

OTHER PROTECTIVE EQUIPMENT:
As needed to prevent contact with eyes.

TSCA: The intentional ingredients of this product are listed.

CERCLA RQ - 40 CFR 302.4(a): None listed.

SARA 302 Components - 40 CFR 355 Appendix A: None listed.

Section 311/312 Hazard Class - 40 CFR 370.2:
Fire: No
Reactivity: No
Acute: Yes
Chronic: No
Pressure Generating: No

SARA 313 Components - 40 CFR 372.65: None

OSHA Process Safety Management - 29 CFR 1910.119: None listed

EPA Accidental Release Prevention - 40 CFR 68.130: None listed

ACGIH = American Conference of Governmental Industrial Hygienists
CL = Ceiling Level
IARC = International Agency for Research on Cancer: Monographs
OSHA = Occupational Safety and Health Administration
NA = Not Applicable
NTP = National Toxicology Program: Annual Report on Carcinogens
PEL = Permissible Exposure Level (OSHA)
TLV = Threshold Limit Value (ACGIH)
TWA = Time Weighted Average over 8 Hours
STEL = Short Term Exposure Limit (ACGIH)
ND = Not Determined

This information is, to the best of our knowledge, accurate but may not be complete. THATCHER COMPANY furnishes this information in good faith, but without warranty, representation or guarantee of its accuracy, completeness, or reliability.

Material Data Safety Sheet (MSDS): PHOSPHORIC ACID

1. Product Identification	7. Handling and Storage
2. Composition	8. Exposure Controls/Personal Protection
3. Hazards Identification	9. Physical and Chemical Properties
4. First Aid Measures	10. Stability and Reactivity
5. Fire Fighting Measures	11. Toxicological Information
6. Accidental Release Measures	12. Ecological Information
	13. Disposal Considerations
	16. Other Information

Note: This information sheet has been re-formatted for better clarity by the Department of Earth Sciences. Some of the data such as information on shipping and weapons treaties were intentionally left out. If you want to look at the complete MSDS, you can either check one of the hardcopy versions in the Department, contact the manufacturer, or check one of the various Web-based databases such as those compiled by BU's Office of Environmental Health & Safety (www.bu.edu/ehs/msds/index.htm).
Return to MSDS Index

1. Product Identification

MSDS Name: **Phosphoric acid**, reagent ACS, 85%

Synonym: Orthophosphoric acid
Company Identification: Acros Organics N.V.
One Reagent Lane
Fairlawn, NJ 07410
For information in North America, call: 800-ACROS-01
For emergencies in the US, call CHEMTREC: 800-424-9300

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MSDS Index

2. Composition/Information on Ingredients

CAS#	Chemical Name	%	EINECS#
7664-38-2	Phosphoric acid	85%	231-633-2
7732-18-5	Water	Balance	231-791-2

Hazard Symbols: C
Risk Phrases: 34

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MSDS Index

SPECTRUM®

Material Safety Data Sheet

NFPA	HMIS	Personal Protective Equipment
0	3 0 Reactivity 0	See Section 15.

Section 1. Chemical Product and Company Identification

Page Number: 1

Common Name/ Trade Name	**Phosphoric acid, 85%**	Catalog Number(s).	P1095, P1097, PH175, YY614
		CAS#	Mixture.
Manufacturer	SPECTRUM LABORATORY PRODUCTS INC. 14422 S. SAN PEDRO STREET GARDENA, CA 90248	RTECS	Not applicable.
		TSCA	TSCA 8(b) inventory: Phosphoric Acid; Water
Commercial Name(s)	Not available.	CI#	Not available.
Synonym	Phosphoric Acid 85%; Phosphoric Acid; Orthophosphoric acid	IN CASE OF EMERGENCY CHEMTREC (24hr) 800-424-9300	
Chemical Name	Not applicable.		
Chemical Family	Not available.	CALL (310) 516-8000	
Chemical Formula	Not applicable.		
Supplier	SPECTRUM LABORATORY PRODUCTS INC. 14422 S. SAN PEDRO STREET GARDENA, CA 90248		

Section 2.Composition and Information on Ingredients

		Exposure Limits			
Name	CAS #	TWA (mg/m³)	STEL (mg/m³)	CEIL (mg/m³)	% by Weight
1) Phosphoric Acid 2) Water	7664-38-2 7732-18-5	1	3		85-88 12-15

Toxicological Data on Ingredients

Phosphoric Acid:
ORAL (LD50): Acute: 1530 mg/kg [Rat].
DERMAL (LD50): Acute: 2740 mg/kg [Rabbit].
DUST (LC50): Acute: >850 mg/m³ 1 hours [Rat].

Section 3. Hazards Identification

Potential Acute Health Effects: Very hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, . Hazardous in case of skin contact (corrosive, permeator), of eye contact (corrosive). Slightly hazardous in case of inhalation (lung sensitizer). Liquid or spray mist may produce tissue damage particularly on mucous membranes of eyes, mouth and respiratory tract. Skin contact may produce burns. Inhalation of the spray mist may produce severe irritation of respiratory tract, characterized by coughing, choking, or shortness of breath. Severe over-exposure can result in death. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Continued on Next Page

Potential Chronic Health Effects	**CARCINOGENIC EFFECTS:** Not available. **MUTAGENIC EFFECTS:** Not available. **TERATOGENIC EFFECTS:** Not available. **DEVELOPMENTAL TOXICITY:** Not available. The substance may be toxic to blood, liver, skin, eyes, bone marrow. Repeated or prolonged exposure to the substance can produce target organs damage. Repeated or prolonged contact with spray mist may produce chronic eye irritation and severe skin irritation. Repeated or prolonged exposure to spray mist may produce respiratory tract irritation leading to frequent attacks of bronchial infection. Repeated exposure to a highly toxic material may produce general deterioration of health by an accumulation in one or many human organs.

Section 4. First Aid Measures

Eye Contact	Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. 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. Cover the irritated skin with an emollient. Cold water may be used.Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.
Serious Skin Contact	Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.
Inhalation	If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.
Serious Inhalation	Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.
Ingestion	Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.
Serious Ingestion	Not available.

Section 5. Fire and Explosion Data

Flammability of the Product	Non-flammable.
Auto-Ignition Temperature	Not applicable.
Flash Points	Not applicable.
Flammable Limits	Not applicable.
Products of Combustion	Not available.
Fire Hazards in Presence of Various Substances	Not applicable.
Explosion Hazards in Presence of Various Substances	Non-explosive in presence of open flames and sparks, of shocks.
Fire Fighting Media and Instructions	Not applicable.
Special Remarks on Fire Hazards	Not available.
Special Remarks on Explosion Hazards	Mixtures with nitromethane are explosive (Phosphoric Acid)

Continued on Next Page

Section 6. Accidental Release Measures

Small Spill	Dilute with water and mop up, or absorb with an inert dry material and place in an appropriate waste disposal container. If necessary: **Neutralize the residue with a dilute solution of sodium carbonate.**
Large Spill	Corrosive liquid. Poisonous liquid. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Do not touch spilled material. Use water spray curtain to divert vapor drift. Use water spray to reduce vapors. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. **Neutralize the residue with a dilute solution of sodium carbonate.** Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7. Handling and Storage

Precautions	Keep locked up.. Keep container dry. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Never add water to this product. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents, combustible materials, metals, alkalis. May corrode metallic surfaces. Store in a metallic or coated fiberboard drum using a strong polyethylene inner package.
Storage	Keep container tightly closed. Keep container in a cool, well-ventilated area. Do not store above 23°C (73.4°F).

Section 8. Exposure Controls/Personal Protection

Engineering Controls	Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.
Personal Protection	Face shield. Full suit. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves. Boots.
Personal Protection in Case of a Large Spill	Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.
Exposure Limits	**Phosphoric Acid** TWA: 1 STEL: 3 (mg/m^3) from ACGIH (TLV) [United States] TWA: 1 STEL: 3 (mg/m^3) from OSHA (PEL) [United States] TWA: 1 STEL: 3 (mg/m^3) from NIOSH TWA: 1 STEL: 3 (mg/m^3) [Mexico] Consult local authorities for acceptable exposure limits.

Section 9. Physical and Chemical Properties

Physical state and appearance	Liquid. (Syrupy liquid Viscous liquid.)	Odor	Odorless.
Molecular Weight	Not applicable.	Taste	Acid.
pH (1% soln/water)	Acidic.	Color	Clear Colorless.
Boiling Point	158°C (316.4°F)		
Melting Point	21°C (69.8°F)		
Critical Temperature	Not available.		
Specific Gravity	1.685 @ 25 C (Water = 1)		
Vapor Pressure	0.3 kPa (@ 20°C)		
Vapor Density	3.4 (Air = 1)		
Volatility	Not available.		
Odor Threshold	Not available.		

Continued on Next Page

Water/Oil Dist. Coeff.	Not available.
Ionicity (in Water)	Not available.
Dispersion Properties	See solubility in water.
Solubility	Easily soluble in hot water. Soluble in cold water.

Section 10. Stability and Reactivity Data

Stability	The product is stable.
Instability Temperature	Not available.
Conditions of Instability	Incompatible materials
Incompatibility with various substances	Reactive with oxidizing agents, combustible materials, metals, alkalis.
Corrosivity	Extremely corrosive in presence of copper, of stainless steel(304), of stainless steel(316). Highly corrosive in presence of aluminum. Non-corrosive in presence of glass.
Special Remarks on Reactivity	Reacts with metals to liberate flammable hydrogen gas. Incompatible with sodium tetrahydroborate producing a violent exothermic reaction. Heat generated with: alcohols, glycols, aldehydes, amides, amines, azo-compounds, carbamates, caustics, esters, ketones, phenols and cresols, organophosphates, epoxides, combustible materials, unsaturated halides, organic peroxides. Formation of flammable with aldehydes, cyanides, mercaptins, and sulfides. Formation of toxic fumes with cyanides, fluorides, halogenated organics, sulfides, and organic peroxides. Do not mix with solutions containing bleach or ammonia. (Phosphoric Acid)
Special Remarks on Corrosivity	Minor corrosive effect on bronze. Severe corrosive effect on brass. Corrosive to ferrous metals and alloys.
Polymerization	Will not occur.

Section 11. Toxicological Information

Routes of Entry	Absorbed through skin. Dermal contact. Eye contact. Inhalation. Ingestion.
Toxicity to Animals	Acute oral toxicity (LD50): 1530 mg/kg [Rat]. Acute dermal toxicity (LD50): 2740 mg/kg [Rabbit].
Chronic Effects on Humans	May cause damage to the following organs: blood, liver, skin, eyes, bone marrow.
Other Toxic Effects on Humans	Extremely hazardous in case of inhalation (lung corrosive). Very hazardous in case of skin contact (irritant), of ingestion, . Hazardous in case of skin contact (corrosive, permeator), of eye contact (corrosive).
Special Remarks on Toxicity to Animals	Not available.
Special Remarks on Chronic Effects on Humans	Not available.
Special Remarks on other Toxic Effects on Humans	Acute Potential Health Effects: Skin: Corrosive and causes severe skin irritation and can cause severe skin burns. May affect behavior (somnolence or excitement) if absorbed through skin. Eyes: Corrosive. Liquid or vapor causes severe eye irritation and can cause severe eye burns leading to permanent corneal damage or chemical conjunctivitis. Ingestion: May be harmful if swallowed. Causes irritation and burns of the gastrointestinal (digestive) tract. Causes severe pain, nausea, vomiting, diarrhea hematemesis, gastrointestinal hemmorrhaging, and shock. May cause corrosion and permanent tissue destruction of the esophagus and digestive tract. May affect behavior and urinary system, liver (hepatocellular damage, hepatic enzymes increased), blood (blood dyscrasia). May also cause Hypocalcemia, Hyperphosphatemia or Hypophosphatemia, and acidosis.

Continued on Next Page

Inhalation: May be harmful if inhaled. Causes irritation and burns of the respiratory tract and mucous membranes with sore throat, coughing, shortness of breath and delayed lung edema.
Chronic Potential Health Effects:
Repeated or Prolonged skin contact may cause dermatitis.
Prolonged or repeated eye contact may cause conjunctivitis.
Chronic exposure may also cause liver damage.
Inhalation of vapors at high concentrations may produce pulmonary edema.

Section 12. Ecological Information

Ecotoxicity	Not available.
BOD5 and COD	Not available.
Products of Biodegradation	Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.
Toxicity of the Products of Biodegradation	The products of degradation are less toxic than the product itself.
Special Remarks on the Products of Biodegradation	Not available.

Section 13. Disposal Considerations

Waste Disposal	Waste must be disposed of in accordance with federal, state and local environmental control regulations.

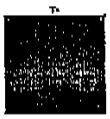
Section 14. Transport Information

DOT Classification	Class 8: Corrosive material
Identification	: Phosphoric acid (Phosphoric Acid) UNNA: 1805 PG: III
Special Provisions for Transport	Not available.
DOT (Pictograms)	

Section 15. Other Regulatory Information and Pictograms

Federal and State Regulations	Connecticut hazardous material survey.: Phosphoric Acid Illinois toxic substances disclosure to employee act: Phosphoric acid Illinois chemical safety act: Phosphoric acid New York release reporting list: Phosphoric acid Rhode Island RTK hazardous substances: Phosphoric acid Pennsylvania RTK: Phosphoric acid Minnesota: Phosphoric acid Massachusetts RTK: Phosphoric acid Massachusetts spill list: Phosphoric acid New Jersey: Phosphoric acid New Jersey spill list: Phosphoric acid Louisiana spill reporting: Phosphoric acid California Director's list of hazardous substances: Phosphoric acid TSCA 8(b) inventory: Phosphoric Acid; Water SARA 313 toxic chemical notification and release reporting: Phosphoric acid CERCLA: Hazardous substances.: Phosphoric acid: 5000 lbs. (2268 kg)

Continued on Next Page

California Proposition 65 Warnings	California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer which would require a warning under the statute: No products were found. California prop. 65: This product contains the following ingredients for which the State of California has found to cause birth defects which would require a warning under the statute: No products were found.		
Other Regulations	OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).		
Other Classifications	WHMIS (Canada)	CLASS E: Corrosive liquid.	
	DSCL (EEC)	R34- Causes burns.	S26- In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. S45- In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).
HMIS (U.S.A.)	3 0 Reactivity 0 Personal Protection	National Fire Protection Association (U.S.A.)	Health 0 Flammability Reactivity Specific hazard
WHMIS (Canada) (Pictograms)			
DSCL (Europe) (Pictograms)			
TDG (Canada) (Pictograms)			
ADR (Europe) (Pictograms)			
Protective Equipment		Gloves.	
		Full suit.	
		Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.	
		Face shield.	

Continued on Next Page

Section 16. Other Information

MSDS Code	P3690
References	Not available.
Other Special Considerations	Not available.

Validated by Sonia Owen on 7/19/2004.	Verified by Sonia Owen. Printed 8/25/2004.

CALL (310) 516-8000

Notice to Reader

All chemicals may pose unknown hazards and should be used with caution. This Material Safety Data Sheet (MSDS) applies only to the material as packaged. If this product is combined with other materials, deteriorates, or becomes contaminated, it may pose hazards not mentioned in this MSDS. It shall be the user's responsibility to develop proper methods of handling and personal protection based on the actual conditions of use. While this MSDS is based on technical data judged to be reliable, Spectrum Quality Products, Inc. assumes no responsibility for the completeness or accuracy of the information contained herein.

MATERIAL SAFETY DATA SHEET

1. IDENTIFICATION OF THE PRODUCT AND THE COMPANY

CLARIFLOC® A-210P POLYMER

Supplier :

POLYDYNE INC.

PO Box 279
Riceboro, GA 31323
Tel : 912-884-8775 Fax : 912-884-8770

2. COMPOSITION/INFORMATION ON INGREDIENTS

Identification of the preparation : Anionic water-soluble polymer

Hazardous characteristics (irritation) were observed only in the product when tested as a whole, not in individual components.

3. HAZARDS IDENTIFICATION

Irritating to eyes and skin.

Spills produce extremely slippery surfaces.

4. FIRST AID MEASURES

Inhalation : Move to fresh air.

Skin contact : Wash off immediately with soap and plenty of water. In case of persistent skin irritation, consult a physician.

Eye contact : Rinse thoroughly with plenty of water, also under the eyelids. In case of persistent eye irritation, consult a physician.

Ingestion : The product is not considered toxic based on studies on laboratory animals.

5. FIRE-FIGHTING MEASURES

Suitable extinguishing media : Water, water spray, foam, dry powder, carbon dioxide (CO_2)

Special fire-fighting precautions : Spills produce extremely slippery surfaces.

Protective equipment for firefighters : No special protective equipment required.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions : No special precautions required.

Environmental precautions : Do not contaminate water.

Methods for cleaning up : Do not flush with water. Dam up. Soak up with inert absorbent material. If liquid has been spilled in large quantities clean up promptly by scoop or vacuum. Keep in suitable and closed containers for disposal. After cleaning, flush away traces with water.

7. HANDLING AND STORAGE

Handling : Avoid contact with skin and eyes. When preparing the working solution ensure there is adequate ventilation. When using do not smoke.

Storage : Keep in a dry, cool place (0 - 30°C). When preparing the working solution ensure there is adequate ventilation. Freezing will affect the physical condition and may damage the material.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Engineering controls : Use local exhaust if misting occurs. Natural ventilation is adequate in absence of mists.

Personal protection equipment

- ***Respiratory protection :*** In case of insufficient ventilation wear suitable respiratory equipment.
- ***Hand protection :*** Rubber gloves.
- ***Eye protection :*** Safety glasses with side-shields. Do not wear contact lenses
- ***Skin protection :*** Chemical resistant apron or protective suit if splashing or contact with solution is likely.

Hygiene measures : Wash hands before breaks and immediately after handling the product. Handle in accordance with good industrial hygiene and safety practice.

9. PHYSICAL AND CHEMICAL PROPERTIES

Form : viscous liquid

Color : milky

Odor : aliphatic

pH : 6 - 8 @ 5 g/l for product series. See Technical Bulletin for specific value.

Melting point (°C) : Not applicable.

Flash point (°C) :	>100°C
Autoignition temperature (°C) :	>200°C
Vapour pressure (mm Hg) :	0.002 @ 20°C
Bulk density :	See Technical Bulletin
Water solubility :	See Technical Bulletin
Viscosity (mPa s) :	See Technical Bulletin

10. STABILITY AND REACTIVITY

Stability :	Product is stable, No hazardous polymerization will occur.. Oxidizing agents may cause exothermic reactions.
Hazardous decomposition products :	Thermal decomposition may produce : carbon oxides, nitrogen oxides (NOx).

11. TOXICOLOGICAL INFORMATION

Acute toxicity

- Oral :	LD50/oral/rat > 5000 mg/kg
- Dermal :	The product is not expected to be toxic in contact with the skin.
- Inhalation :	The product is not expected to be toxic by inhalation.

Irritation

- Skin :	Irritating to skin.
- Eyes :	Irritating to eyes.
Sensitization :	The product is not expected to be sensitizing.
Chronic toxicity :	Prolonged skin contact may defat the skin and produce dermatitis.

12. ECOLOGICAL INFORMATION

- Fish	LC50/Fathead minnows/96h > 1000 mg/l
- Algae :	EC50 /72h/Phaeodactylum tricornumtum > 1000 mg/l
- Daphnia :	LC50 /48h/Chaetogammarus marinus = 15 mg/l

Bioaccumulation : The product is not expected to bioaccumulate.

Persistence / degradability : Not readily biodegradable (40% after 28 days).

13. DISPOSAL CONSIDERATIONS

Waste from residues / unused products : In accordance with federal, state and local regulations.

Contaminated packaging : Rinse empty containers with water and use the rinse water to prepare the working solution. Can be landfilled or incinerated, when in compliance with local regulations

14. TRANSPORT INFORMATION

Not regulated by DOT.

15. REGULATORY INFORMATION

All components of this product are on the TSCA and DSL inventories.

RCRA status : Not a hazardous waste.

Hazardous waste number : Not applicable

Reportable quantity (40 CFR 302) : Not applicable

Threshold planning quantity (40 CFR 335) : Not applicable

California Proposition 65 Information : *The following statement is made in order to comply with the California Safe Drinking Water and Toxic Enforcement Act of 1986:* This product contains a chemical(s) known to the State of California to cause cancer : acrylamide.

HMIS & NFPA Ratings		**NFPA**
Health :	1	1
Flammability :	1	1
Reactivity :	0	0

16. OTHER INFORMATION

Person to contact : Regulatory Affairs Manager

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release, and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process unless specified in the text.

** Material Safety Data Sheet **

Univar USA Inc.
6100 Carillon Point
Kirkland, WA 98033
USA
www.univarusa.com

UNIVAR

Date	11/08/04
To	BATTLLLE
Attn.	WENDY CONDIT
Fax	1614-458-3501
From	PAM CARTER at UNIVAR USA
fax direct	
Total pages (incl. this one)	6
subject / your reference	MSDS – ACETIC ACID, DILUTE 50-80%

FAX

E-mail direct telephone direct Kirkland, WA 98033

For emergency assistance involving chemicals, call CHEMTREC – (800) 424-9300

** Material Safety Data Sheet **

immediately.

Skin: Immediately flush with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Get medical attention immediately. Wash contaminated clothing before reuse. Destroy or thoroughly clean contaminated shoes.

Ingestion: Call a physician or poison control center immediately. Do NOT induce vomiting. If victim is fully conscious, give a cupful of water. Never give anything by mouth to an unconsious person. If vomiting occurs, keep head lower than the hips to help prevent aspiration.

5. FIRE FIGHTING MEASURES

Extinguishing Media: water spray, dry chemical, carbon dioxide, alcohol foam

Special Fire-Fighting Procedures:
Wear self-contained breathing apparatus and protective clothing.
Use water spray to keep fire-exposed containers cool.

Hazardous Combustion Products: carbon dioxide, carbon monoxide

Unusual Fire and Explosion Hazards: Combustible.

Sensitivity to Static Discharge:
Material is unlikely to accumulate a static charge which could act as an ignition source.

6. ACCIDENTAL RELEASE MEASURES

Use personal protective equipment. Eliminate all ignition sources. Neutralize with soda ash lime Absorb spill with vermiculite or other inert material, then place in a container for chemical waste.

For Large Spills: Use water spray to disperse vapors and flush spill area. Prevent runoff from entering drains, sewers, or streams. Dike for later disposal.

7. HANDLING AND STORAGE

Personal Precautionary Measures: Avoid breathing vapor. Do not get in eyes, on skin, on clothing. Do not taste or swallow. Use only with adequate ventilation. Wash thoroughly after handling.

Prevention of Fire and Explosion: Keep away from heat and flame. Keep from contact with oxidizing materials.

Storage: Keep container closed.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Country specific exposure limits have not been established or are not applicable unless listed below.

ACETIC ACID
US. ACGIH Threshold Limit Values
Time Weighted Average (TWA): 10 ppm,
US. ACGIH Threshold Limit Values

Short Term Exposure Limit (STEL): 15 ppm,
US. NIOSH: Pocket Guide to Chemical Hazards
Recommended exposure limit (REL): 10 ppm, 25 mg/m3
US. NIOSH: Pocket Guide to Chemical Hazards
Short Term Exposure Limit (STEL): 15 ppm, 37 mg/m3
US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000)

PEL: 10 ppm, 25 mg/m3
US. California Code of Regulations, Title 8, Section 5155. Airborne Contaminants
Time Weighted Average (TWA) Permissible Exposure Limit (PEL): 10 ppm, 25 mg/m3
US. California Code of Regulations, Title 8, Section 5155. Airborne Contaminants
Ceiling Limit Value: 40 ppm,
US. California Code of Regulations, Title 8, Section 5155. Airborne Contaminants
Short Term Exposure Limit (STEL): 15 ppm, 37 mg/m3

Ventilation:
Good general ventilation (typically 10 air changes per hour) should be used. Ventilation rates should be matched to conditions. If applicable, use process enclosures, local exhaust ventilation, or other engineering controls to maintain airborne levels below recommended exposure limits. If exposure limits have not been established, maintain airborne levels to an acceptable level.

Respiratory Protection:
If engineering controls do not maintain airborne concentrations below recommended exposure limits (where applicable) or to an acceptable level (in countries where exposure limits have not been established), an approved respirator must be worn. In the United States of America, if respirators are used, a program should be instituted to assure compliance with OSHA Standard 63 FR 1152, January 8, 1998. Respirator type: Air-purifying respirator with an appropriate, government approved (where applicable), air-purifying filter, cartridge or canister. Contact health and safety professional or manufacturer for specific information.

Eye Protection: Wear safety glasses with side shields (or goggles). Wear a full-face respirator, if needed.

Skin Protection: Wear chemical-resistant gloves, footwear, and protective clothing appropriate for the risk of exposure. Contact health and safety professional or manufacturer for specific information.

Recommended Decontamination Facilities:
eye bath, safety shower, washing facilities

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical Form:	liquid
Color:	colorless
Odor:	pungent, vinegar
Odor Threshold for (acetic acid):	0.48 ppm
Specific Gravity:	> 1
Vapor Pressure for (acetic acid):	20 C; 15.2 mbar
Vapor Density for (acetic acid):	2.1
Boiling Point:	102 - 118 C
Solubility in Water:	complete
Flash Point:	71 - 91 C
Thermal Decomposition Temperature:	Thermal stability not tested. Low stability hazard expected at normal operating temperatures.

10. STABILITY AND REACTIVITY

Stability: Stable.

Incompatibility: Material reacts with strong oxidizing agents, metals, strong bases, amines.

Hazardous Polymerization: Will not occur.

11. TOXICOLOGICAL INFORMATION

Acute toxicity data, if available, are listed below. Additional toxicity data may be available on request.

Data for major component
Oral LD-50:(rat) 3,310 - 3,530 mg/kg
Oral LD-50:(mouse) 4,960 mg/kg
Inhalation LC-50: (mouse) 1 h: 5620 ppm
Dermal LD-50: (rabbit) 1,060 mg/kg
Skin Irritation (rabbit) severe
Eye Irritation (rabbit) severe

12. ECOLOGICAL INFORMATION

Acute toxicity data, if available, are listed below. Additional toxicity data may be available on request.

This material is a strongly acidic aqueous solution, and this property may cause adverse environmental effects.

Data for a major component:
Oxygen Demand Data:
BOD-5: 340 - 880 mg/g
COD: 1,000 mg/g

Acute Aquatic Effects Data:
96 h LC-50 (fathead minnow): > 100 mg/l
48 h LC-50 (mosquito fish): 251 mg/l
48 h LC-50 (golden orfe): 410 mg/l
96 h LC-50 (daphnid): 100 mg/l

13. DISPOSAL CONSIDERATIONS

Discharge, treatment, or disposal may be subject to national, state, or local laws. Incinerate. Since emptied containers retain product residue, follow label warnings even after container is emptied.

14. TRANSPORT INFORMATION

Marine pollutant components: none unless listed below
Reportable Quantity: 2,837 kg

DOT (USA): Class 8 Packing group II
ICAO Status: Class 8 Packing group II
IMDG Status: Class 8 Packing group II

15. REGULATORY INFORMATION

WHMIS (Canada) Status: controlled
WHMIS (Canada) Hazard Classification: B/3, E

SARA 311-312 Hazard Classification(s):
immediate (acute) health hazard
fire hazard

SARA 313: none, unless listed below

Carcinogenicity Classification (components present at 0.1% or more): none, unless listed below

TSCA (US Toxic Substances Control Act): All components of this product are listed on the TSCA inventory. Any impurities present in this product are exempt from listing.

DSL (Canadian Domestic Substances List) and CEPA (Canadian Environmental Protection Act): All components of this product are listed on the DSL. Any

impurities present in this product are exempt from listing.

EINECS (European Inventory of Existing Commercial Chemical Substances): All components of this product are listed on EINECS.

AICS / NICNAS (Australian Inventory of Chemical Substances and National Industrial Chemicals Notification and Assessment Scheme): All components of this product are listed on AICS or otherwise comply with NICNAS.

MITI (Japanese Handbook of Existing and New Chemical Substances): All components of this product are listed in the Handbook or have been approved in Japan by new substance notification.

ECL (Korean Toxic Substances Control Act): All components of this product are listed on the Korean inventory or otherwise comply with the Korean Toxic Substances Control Act.

16- OTHER INFORMATION

---------- FOR ADDITIONAL INFORMATION ----------
CONTACT: MSDS COORDINATOR UNIVAR USA INC.
DURING BUSINESS HOURS, PACIFIC TIME (425)889-3400
---------- NOTICE ----------

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* * * E N D O F M S D S * * *

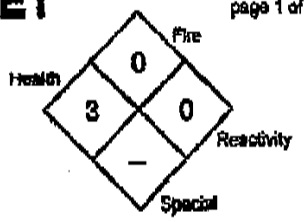
MATERIAL SAFETY DATA SHEET

LA CHEMICAL

L.A. CHEMICAL CO MSDS #	93901
MSDS Revision/Issue Date:	02/04/95
Supercedes Revision Date:	09/06/94

NFPA 704 DESIGNATION
HAZARD RATING

4=Extreme
3=High
2=Moderate
1=Slight
0=Insignificant



1. CHEMICAL PRODUCT IDENTIFICATION & COMPANY IDENTIFICATION

PRODUCT IDENTIFIER: **FERRIC CHLORIDE SOLUTION, 30 - 48 °Be**

GENERAL USE: Ferric chloride solutions are used in photoengraving; as a catalyst in organic reactions; purifying factory effluents and deodorizing sewage; and as a mordant in dyeing and printing textiles.

PRODUCT DESCRIPTION: An acidic, aqueous solution of ferric chloride. Synonyms include: flores martis, iron chloride, iron (III) chloride, iron sesquichloride, and iron trichloride.

INFORMATION PROVIDED BY: L.A. CHEMICAL CO
Corporate Office
4545 Ardine Street
South Gate, CA 90280
For MSDS call: Phone: 323-562-9500 Fax: 323-773-0909

EMERGENCY PHONE NUMBERS

L.A. CHEMICAL CO :	323-562-9500
CHEMTREC:	800-424-9300
CANUTEC:	613-996-6666

2. COMPOSITION & INFORMATION ON INGREDIENTS

COMPONENT	CAS #	OSHA HAZARD	WT %	ACGIH TLV(TWA)	ACGIH STEL	OSHA PEL(TWA)	OSHA STEL
Ferric Chloride	007705-08-0	Corrosive; Toxic by Ingestion; Liver Toxin	28 – 48	1 mg/m³ (as Fe)	N/A	N/A	N/A
Hydrochloric Acid	007647-01-0	Corrosive; Lung Toxin	0.5 (maximum)	N/A; Ceiling: 5 ppm	N/A	N/A; Ceiling: 5 ppm	N/A

NDA = No Data Available N/A = Not Applicable

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW: A yellow to dark reddish-brown liquid with a pungent acidic odor. Vapors, mists, and liquid may cause severe irritation or burns to eyes, skin, respiratory tract, and gastrointestinal tract. The NIOSH I.D.L.H. for hydrogen chloride is: 50 ppm.

POTENTIAL HEALTH EFFECTS

INHALATION: Exposure to vapors or mists may cause severe irritation or burns to the respiratory tract. Symptoms of exposure may include: coughing, choking, and a burning sensation. At high concentrations severe breathing difficulties may occur.

EYE CONTACT: Exposure to vapors, mists, and liquids may cause severe eye irritation or burns. Symptoms of exposure may include tearing, redness, and swelling. Direct contact with the liquid may cause corneal damage and/or visual impairment.

SKIN CONTACT: Exposure to vapors or mists may cause severe skin irritation or burns. Symptoms of exposure may include: redness, swelling, a stinging sensation, and pain. No published reports indicate this product is absorbed through the skin.

INGESTION: Ingestion may cause severe irritation or burns to the gastrointestinal tract. Symptoms of exposure may include: nausea, vomiting, diarrhea, abdominal pain, bleeding, and tissue ulceration, with possible coma and death.

CHRONIC: Ingestion can cause liver damage. Prolonged skin exposure to product may cause destruction of the dermis with impairment of the skin, at the site of contact, to regenerate. Otherwise, the chronic health effects of exposure are the same as for acute exposure.

MATERIAL SAFETY DATA SHEET
Sulfuric Acid

1. PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME: Sulfuric Acid

OTHER/GENERIC NAMES: Battery acid.

PRODUCT USE: Industrial.

MANUFACTURER:
General Chemical Corp
90 East Halsey Rd.
Parsippany, NJ 07054

FOR MORE INFORMATION CALL:
(Monday-Friday, 8:00am-4:30pm) 973-515-1940

IN CASE OF EMERGENCY CALL:
(24 Hours/Day, 7 Days/Week) 800-631-9050

2. COMPOSITION/INFORMATION ON INGREDIENTS

INGREDIENT NAME CAS NUMBER	WEIGHT %	OSHA PEL
Water [illegible]	0-81	None
Sulfuric acid [illegible]	>51	1 mg/m3 TWA

Trace impurities and additional material names not listed above may also appear in Section 15 towards the end of the MSDS. These materials may be listed for local "Right-to-Know" compliance and for other reasons.

OSHA Hazard Communication Standard: This product is considered hazardous under the OSHA Hazard Communication Standard.

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW: Oily, colorless to slightly yellow, clear to turbid liquid. Odorless.

MATERIAL SAFETY DATA SHEET
Sulfuric Acid

Causes severe skin burns. Causes severe eye burns. Causes burns of the mouth, throat, and stomach.

POTENTIAL HEALTH HAZARDS:

SKIN: Causes severe burns.

EYES: Liquid contact can cause irritation, corneal burns, and conjunctivitis. May result in severe or permanent injury. May cause blindness.

INHALATION: Inhalation of fumes or acid mist can cause irritation or corrosive burns to the upper respiratory system, including the nose, mouth and throat. May irritate the lungs. May cause pulmonary edema.

INGESTION: Causes burns of the mouth, throat and stomach. May be fatal if swallowed. Hazards are also applicable to dilute solutions.

DELAYED EFFECTS: Erosion of teeth, lesions of the skin, tracheo-bronchitis, mouth inflammation, conjunctivitis and gastritis.IARC and NTP have classified "strong inorganic acid mists containing sulfuric acid" as a known human carcinogen. This classification is for inorganic acid mists only and does not apply to sulfuric acid or sulfuric acid solutions. The basis for the classifications rests on several epidemiology studies which have several deficiencies. These studies did not account for exposure to other substances, some known to be animal or potential human carcinogens, social influences (smoking or alcohol consumption) and included small numbers of subjects. Based on the overall weight of evidence from all human and chronic animal studies, no definitive causal relationship between sulfuric acid mist exposure and respiratory tract cancer has been shown.

Ingredients found on one of the three OSHA designated carcinogen lists are listed below.

INGREDIENT NAME CAS NUMBER	WEIGHT %	NTP STATUS	IARC STATUS	OSHA LIST
Water 7732-18-5	0-99	Not listed	Not listed	Not listed
Sulfuric acid 7664-93-9	>51	Known carcinogen - sulfuric acid mist	1 - Known carcinogen; Sulfuric acid mist	Not listed

MATERIAL SAFETY DATA SHEET
Sulfuric Acid

4. FIRST AID MEASURES

SKIN: Immediately flush skin with plenty of water for at least 15 minutes. Remove contaminated clothing while washing. Get medical attention immediately.

EYES: Immediately flush eyes with large amounts of water for at least 15 minutes. Get immediate medical attention.

INHALATION: If inhaled, remove to fresh air. If not breathing give artificial respiration, preferably mouth-to-mouth. If breathing is difficult give oxygen. Get medical attention.

INGESTION: If swallowed, do NOT induce vomiting. Give victim two glasses of water. Call a physician immediately. Never give anything by mouth to an unconscious person.

ADVICE TO PHYSICIAN: Treat symptomatically.

5. FIRE FIGHTING MEASURES

FLAMMABLE PROPERTIES

FLASH POINT:	Not applicable.
FLASH POINT METHOD:	Not applicable.
AUTOIGNITION TEMPERATURE:	Not applicable.
UPPER FLAME LIMIT (volume % in air):	Not applicable.
LOWER FLAME LIMIT (volume % in air):	Not applicable.
FLAME PROPAGATION RATE (solids):	Not applicable.
OSHA FLAMMABILITY CLASS:	Not flammable.

EXTINGUISHING MEDIA:
Water spray or fog may be used to knock down corrosive vapor cloud. Water may be applied to the sides of the containers exposed to flames provided the water does not come in contact with the tank contents.

UNUSUAL FIRE AND EXPLOSION HAZARDS:
Flammable and potentially explosive hydrogen gas can be generated inside metal drums and storage tanks. Concentrated sulfuric acid can ignite combustible materials on contact.

MATERIAL SAFETY DATA SHEET
Sulfuric Acid

SPECIAL FIRE-FIGHTING PRECAUTIONS/INSTRUCTIONS:
Do not use solid water streams near ruptured tanks or spills of sulfuric acid. Acid reacts violently with water and can spatter acid onto personnel. Wear approved positive-pressure self-contained breathing apparatus and protective clothing.

6. ACCIDENTAL RELEASE MEASURES

IN CASE OF SPILL OR OTHER RELEASE: (See Section 8 for recommended personal protective equipment.)
Dilute small spills or leaks cautiously with plenty of water. Neutralize residue with sodium bicarbonate or other suitable neutralizing agent. When using carbonates for neutralization, adequate precautions should be taken to minimize hazards from carbon dioxide gas generation. No smoking in spill area. Major spills must be handled by a predetermined plan. Attempt to keep out of sewers.

Spills and releases may have to be reported to Federal and/or local authorities. See Section 15 regarding reporting requirements.

7. HANDLING AND STORAGE

NORMAL HANDLING: (See section 8 for recommended personal protective equipment.)
Avoid contact with skin, eyes and clothing. Avoid breathing mist. Use appropriate personnel protective equipment. Do not add water to acid. When diluting, always add acid to water cautiously and with agitation. Use with adequate ventilation.

STORAGE RECOMMENDATIONS:
Protect from physical damage. Store in a cool, well-ventilated area away from combustibles and reactive chemicals. Keep out of sun and away from heat. Keep containers upright. No smoking in storage area.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

ENGINEERING CONTROLS: Sufficient to reduce vapor and acid mists to permissible levels. Packaging and unloading areas and open processing equipment may require mechanical exhaust systems. Corrosion-proof construction recommended. Closed ventilation systems (e.g. vapor hoods) are frequently used in the electronics industry.

PERSONAL PROTECTIVE EQUIPMENT

SKIN PROTECTION: As a minimum, wear acid-resistant, preferably rubber, gloves and apron. Acid-resistant boots, trousers and jacket may be used for increased protection.

EYE PROTECTION: Wear chemical safety goggles. Add a full faceshield for pouring liquids. Do not wear contact lenses.

MATERIAL SAFETY DATA SHEET
Sulfuric Acid

RESPIRATORY PROTECTION: Generally, none required. If misting conditions prevail, wear a NIOSH-approved acid-mist respirator.

ADDITIONAL RECOMMENDATIONS: Provide eyewash stations and quick-drench shower facilities in or near areas of use or handling.

EXPOSURE GUIDELINES

INGREDIENT NAME/ CAS NUMBER	WEIGHT %	ACGIH TLV	OSHA PEL	OTHER LIMIT
Water 7732-18-5	94[1]	None	None	None
Sulfuric acid 7664-93-9	>81	1 mg/m3 TWA; 3 mg/m3 STEL	1 mg/m3 TWA	15 mg/m3 - IDLH

[1] = Limit established by General Chemical Corporation.
[2] = Workplace Environmental Exposure Level (AIHA).
[3] = Biological Exposure Index (ACGIH).

OTHER EXPOSURE LIMITS FOR POTENTIAL DECOMPOSITION PRODUCTS:
None.

9. PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE:	Colorless to light yellow liquid
PHYSICAL STATE:	Liquid
MOLECULAR WEIGHT:	98.08 (H_2SO_4)
CHEMICAL FORMULA:	H_2SO_4 (various concentrations) in water
ODOR:	Odorless
SPECIFIC GRAVITY (water=1.0):	1.842
SOLUBILITY IN WATER (weight %):	100%
pH:	0.3 (1% solution)
BOILING POINT:	~310 C (94%)
MELTING POINT:	~ -27 C (94%)
VAPOR PRESSURE:	<0.001 mm Hg at 20 C
VAPOR DENSITY (air=1.0):	Not applicable.
EVAPORATION RATE:	Not applicable. COMPARED TO: Not applicable.
% VOLATILES:	Not applicable.

MATERIAL SAFETY DATA SHEET
Sulfuric Acid

FLASH POINT: Not applicable.

(Flash point method and additional flammability data are found in Section 5.)

10. STABILITY AND REACTIVITY

NORMALLY STABLE? (CONDITIONS TO AVOID):
Normally stable. Avoid temperatures greater than 300 C: yields sulfur trioxide gas, which is toxic, corrosive, and an oxidizer.

INCOMPATIBILITIES:
Nitro compounds, carbides, dienes, alcohols (when heated): causes explosions.
Oxidizing agents, such as chlorates and permanganates: causes fires and possible explosions.
Alkyl compounds and aldehydes: undergoes polymerization, possibly violent.
Alkalies: anilines, water, hydrated salts, carboxylic acid anhydrides, nitriles, olefinic organics, glycols, aqueous acids: causes strong exothermic reactions.
Carbonates, cyanides, sulfides, sulfites, metals such as copper: yields toxic gases.

HAZARDOUS DECOMPOSITION PRODUCTS:
Sulfur trioxide gas.

HAZARDOUS POLYMERIZATION:
Will not occur.

11. TOXICOLOGICAL INFORMATION

IMMEDIATE (ACUTE) EFFECTS:
For sulfuric acid:
LD50 (oral): 2140 mg/kg
LC50 (rat-vapor): 510 mg/m3/2 hr
LC50 (mouse): 320 mg/m3/2 hr

DELAYED (SUBCHRONIC AND CHRONIC) EFFECTS:
IARC and NTP have classified "strong inorganic acid mist: containing sulfuric acid" as known human carcinogens.
No definitive causal relationship between sulfuric acid mist exposure and respiratory cancer has been shown.

OTHER DATA:
None.

12. ECOLOGICAL INFORMATION

MATERIAL SAFETY DATA SHEET
Sulfuric Acid

Aquatic toxicity:
24.5 ppm/24 hr./bluegill/lethal/fresh water
42.6 ppm/48 hr./prawn/LC50/salt water

13. DISPOSAL CONSIDERATIONS

RCRA

Is the unused product a RCRA hazardous waste if discarded? Yes
If yes, the RCRA ID number is: D002 (corrosive)

OTHER DISPOSAL CONSIDERATIONS:
Disposal should be made in accordance with federal, state and local regulations.

The information offered in section 13 is for the product as shipped. Use and/or alterations to the products such as mixing with other materials may significantly change the characteristics of the material and alter the RCRA classification and the proper disposal method.

14. TRANSPORT INFORMATION

US DOT HAZARD CLASS: 8
PROPER SHIPPING NAME: Sulfuric acid, 8, UN1830, PG II

For additional information on shipping regulations affecting this material, contact the information number found in Section 1.

15. REGULATORY INFORMATION

TOXIC SUBSTANCES CONTROL ACT (TSCA)

TSCA INVENTORY STATUS: Listed on Inventory: YES

OTHER TSCA ISSUES: All components of this product are listed on the TSCA Inventory.

SARA TITLE III/CERCLA:

Reportable Quantities (RQs) and/or Threshold Planning Quantities (TPQs) exist for the following ingredients.

MATERIAL SAFETY DATA SHEET
Sulfuric Acid

INGREDIENT NAME/ CAS NUMBER	WEIGHT %	SARA/CERCLA RQ lbs	SARA 313 TOXIC
Water 7732-18-5	0-51	None	None
Sulfuric acid 7664-93-9	>51	1000 lbs	1000 lbs.

Spills or releases resulting in the loss of any ingredient at or above its RQ require immediate notification to the National Response Center [(800) 424-8802] and to your Local Emergency Planning Committee.

SECTION 311 HAZARD CLASS: Immediate.

SARA 313 TOXIC CHEMICALS:
The following ingredients are SARA 313 "Toxic Chemicals" and may be subject to annual reporting requirements. CAS numbers and weight percents are found in Section 2.

INGREDIENT NAME/ CAS NUMBER	WEIGHT %	COMMENT
Water 7732-18-5	0-51	Not listed
Sulfuric acid 7664-93-9	>51	Listed

STATE RIGHT-TO-KNOW:
The following are listed for state right-to-know purposes.

INGREDIENT NAME/ CAS NUMBER	WEIGHT %	NJ RIGHT-TO-KNOW:	MA RIGHT-TO-KNOW:	PA RIGHT-TO-KNOW:
Water 7732-18-5	0-51	Not listed	Not listed	Not listed
Sulfuric acid 7664-93-9	>51	Listed	Listed	Listed

MATERIAL SAFETY DATA SHEET
Sulfuric Acid

ADDITIONAL REGULATORY INFORMATION:
None.

FOREIGN CHEMICAL CONTROL INVENTORY STATUS :
Listed on Canadian DSL and EINECS.

16. OTHER INFORMATION

CURRENT ISSUE DATE: 03/26/2001

PREVIOUS ISSUE DATE: 08/01/1993

CHANGES TO MSDS FROM PREVIOUS ISSUE DATE ARE DUE TO THE FOLLOWING :
New format. Change in Section 3 - Carcinogen status.

OTHER INFORMATION:
Not Applicable

SQM

PRODUCT DATA SHEET - INDUSTRIAL CHEMICALS

SODIUM NITRATE

Refined Grade - Prilled

GENERAL DESCRIPTION	
CHEMICAL FORMULA	$NaNO_3$
APPEARANCE	White prills
INTERNAL CODE	SSR

CHEMICAL SPECIFICATIONS GUARANTEED				
PURITY	$NaNO_3$	%	99.5	min
CHLORIDE	Cl	%	0.08	max

CHEMICAL SPECIFICATIONS TYPICAL			
SULPHATE	SO_4	%	0.1
NITRITE	NO_2	%	0.02
IRON	Fe	ppm	< 5
COPPER	Cu	ppm	< 1
CHROMIUM	Cr	ppm	< 1
LEAD	Pb	ppm	< 5
ARSENIC	As	ppm	< 0.1
INSOLUBLES		%	0.02
MOISTURE		%	0.1

TYPICAL SIEVE ANALYSIS (CUMULATIVE %)

US Standard Sieve	Tyler	mm	
+8	+8	2.36	2%
+12	+10	1.70	23%
+16	+14	1.18	73%
+20	+20	0.85	98%

PHYSICAL PROPERTIES	
MOLECULAR WEIGHT	84.99
MELTING POINT	308 °C
SOLUBILITY (in water at 20 °C)	88 g/ 100 cm^3
DENSITY (Bulk)	1.22 ton (metric) $/m^3$
SPECIFIC GRAVITY	2.257

Before using this product, please read the product specifications, the material safety data sheet and any other applicable product literature.
The conditions of your use and application of our products, technical assistance and information (whether verbal, written, or by way of production evaluations, including any suggested formulations and recommendations, are beyond our control. Therefore, it is imperative that you test our products, technical assistance and information to determine to your own satisfaction whether they are suitable for your intended uses and applications. This application-specific analysis at least must include testing to determine suitability from a technical as well as health, safety, and environmental standpoint. It is also not recommended that the product be used for any particular purpose without verification by the user of compliance with all applicable laws, regulations and registration requirements. No warranty is made as to the accuracy of any data or measurements contained herein. While this product is furnished in good faith, this product is provided to you without any representation or warranty, expressed or implied, as to quality, condition, utility, merchantability, compliance, suitability or fitness for any particular purpose or use or any other matter or thing whatsoever and without recourse against SQM in any event. Without limiting the generality of the foregoing, SQM specifically disclaims any responsibility or liability relating to the use of this product and shall not in any event be liable for any special, incidental or consequential damages arising from such use.

Dec-00

SQM North America Corp. – Sodium Nitrate

Material Safety Data Sheet

SECTION I — IDENTIFICATION

CHEMICAL NAME	CHEMICAL SYNONYMS	CAS. NO.
Sodium Nitrate	Soda Niter Chile Saltpeter	7631-99-4
CHEMICAL FAMILY	**DESCRIPTION**	**PERCENT (MIN.)**
Nitrates	White Solid Prills (Pellets)	98.0 (Ind); 99.0 (Tech); 99.4 (Refined)
CHEMICAL FORMULA	**GRADE**	**MOL. WT.**
$NaNO_3$	Industrial/Technical/Refined - NITEROX	85.01

SECTION II — MANUFACTURERS INFORMATION

MANUFACTURERS NAME	EMERGENCY TELEPHONE NUMBERS	
Sociedad Quimica y Minera de Chile, S.A., Santiago, Chile	Chemtrec 1-800-424-9300; SQM North America 770-916-9400	
ADDRESS	**FOR INFORMATION**	
SQM North America Corp. 3101 Towercreek Parkway, Suite 450 Atlanta, GA 30339	Phone: 770-916-9400 Fax: 770-916-9401	
	DATA PREPARED	**REVISED**
	May 4, 1989	September 10, 2002

SECTION III — INGREDIENTS INFORMATION

COMPONENT	OSHA PEL	ACGIH TLV	OTHER LIMITS RECOMMENDED	SIGNIFICANT EFFECTS
Sodium Nitrate	No Information Available	None Established	No Information Available	None Established

SECTION IV — FIRE AND EXPLOSION DATA

FLASH POINT (METHOD USED)	FLAMMABLE LIMITS	OSHA CLASSIFICATION
Not Applicable	No information available	Class 1 Oxidizer

FLAMMABLE EXPLOSIVE LIMITS	EXTINGUISHING MEDIA
Upper Limits: Not Applicable Lower Limits: Not Applicable	Small Fires: Dry chemical, CO_2, water spray or foam Large Fires: Water spray, fog or foam

SPECIAL FIRE FIGHTING PROCEDURES

Remove containers from fire if possible without risk. Cool containers exposed to flames with water. Use NIOSH/MSHA approved self- contained breathing apparatus where this material is involved in a fire.

UNUSUAL FIRE AND EXPLOSION HAZARDS

Oxidizer. Keep away from reducing agents. will explode if heated to 1,000°F in presence of reducing agents, organic materials or mixed with cyanides. Yields gaseous oxides when heated above melting point (306.8°C).

SECTION V — HEALTH HAZARD DATA

HEALTH HAZARDS ACUTE EXPOSURE	CHRONIC EXPOSURE
Toxic by ingestion, consumed in cured meats, fish and other food products restricted.	Not Applicable
CARCINOGENICITY	**SYMPTOMS OF OVEREXPOSURE**
Sodium Nitrate has not been directly implicated as a carcinogen. A constant oral intake of nitrate containing foods or water could lead to formation of carcinogenic N-Nitroso compounds.	Not Applicable

EMERGENCY FIRST AID PROCEDURES

SKIN	EYES
Not Applicable	Flush with water.
INGESTION	**INHALATION**
Drink water, induce vomiting by sticking finger down throat, and call a physician.	Not Applicable

SQM North America Corp. -- Sodium Nitrate

SECTION VI — TOXICOLOGY

ACUTE ORAL LD 50 4.3 g/kg (Rats)	**CARCINOGENIC** Not known to be carcinogenic	**PRINCIPLE ROUTES OF ABSORPTION** Not Applicable
ACUTE DERMAL LD 50 Not Determined	**MUTAGENIC** Not known to be mutagenic	**EFFECTS OF ACUTE EXPOSURE** Not Applicable
ACUTE INHALATION LC 50 Not Determined	**EYE/SKIN IRRITATION** May be an irritant	**EFFECTS OF CHRONIC EXPOSURE** None expected at industrial use levels.

SECTION VII — REACTIVITY DATA

STABILITY (UNDER NORMAL CONDITIONS) Stable X Unstable	**HAZARDOUS DECOMPOSITION** Produces oxides of nitrogen.
HAZARDOUS POLYMERIZATION May Occur Will Not Occur X	**INCOMPATIBILITY (MATERIALS TO AVOID)** Avoid contact with reducing agents and flammable or combustible materials.

SECTION VIII — PHYSICAL DATA

BOILING POINT 380°C (Decomposes)	**MELTING POINT** 306.8 °C	**VAPOR PRESSURE** Not Applicable (MM/Hg)	**APPEARANCE** White Prills (Pellets)
SOLUBILITY IN WATER 92 g/100ml at 25°C	**SPECIFIC GRAVITY** 2.26 (H_2O =1)	**VAPOR DENSITY** Not Applicable (Air = 1)	**EVAPORATION RATE** No Information Available

SECTION IX — SAFE HANDLING & USE PRECAUTIONS

WASTE DISPOSAL METHOD Sanitary landfill in accordance with federal, state and local regulations.	**OTHER PRECAUTIONS** Wood and empty paper bags used to hold this product should be removed from the premises.
IN CASE MATERIAL IS RELEASED OR SPILLED Sweep or shovel up spilled material.	**HANDLING AND STORING PRECAUTIONS** Store away from reducing agents and liquids of low flash points.

SECTION IX — CONTROL MEASURES

RESPIRATORY PROTECTION NIOSH/MSHA-Approved dust type respirator.	**VENTILATION** Mechanical (General)
PROTECTIVE GLOVES No special gloves needed.	**EYE PROTECTION** Goggles
OTHER PROTECTIVE CLOTHING OR EQUIPMENT None	**WORK/HYGENIC PRACTICES** Follow recommendations in Section IX.

Material contained herein complies with OSHA communications standard, 29 CFR 1910. 1200. Standard must be consulted for specific requirements. The information contained herein is, to best of our knowledge and belief, accurate. However, SQM Sodium Nitrate is sold without representations or warranties, express or implied, of fitness for use or purpose or of merchantability beyond the description of said material on the face hereof, and is sold on the condition that seller shall not be liable for accident, injury, or damage occasioned during or resulting from the transportation, handling, storage, sale or use of the material. In the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemical call Chemtrec 800-424-9300.

APPENDIX D

Los Angeles County Sanitation District (LACSD) Permit 7024R-2

WATER RECLAMATION
SOLID WASTE MANAGEMENT

COUNTY SANITATION DISTRICTS
OF LOS ANGELES COUNTY

1955 Workman Mill Road, Whittier, CA 90601-1400
Mailing Address: P.O. Box 4998, Whittier, CA 90607-4998
Telephone: (562) 699-7411, FAX: (562) 699-5422
www.lacsd.org

JAMES F. STAHL
Chief Engineer and General Manager

January 21, 2005
File: 16-05-07024Y
Account No. 1710061

Ms. Bonnie Hopkins
City of Pasadena
100 N. Garfield Ave. Rm 212
Pasadena, CA 91109-7215

Dear Ms. Hopkins:

Addendum to Industrial Wastewater Discharge Permit No. 7024 R-2

Jet Propulsion Laboratory
4800 Oak Grove Dr.
Pasadena, CA 91011

Enclosed are two (2) approved sets of plans showing the new groundwater treatment system for the subject company. Please review these for compliance with your requirements, and retain the copies you require for your files. The applicant's copy of the approved plans along with a copy of this letter and requirement list, should be forwarded to the applicant. A copy of this letter is forwarded to the applicant as notification of the Districts' permit requirements, which are in force from the current date. If any additional permit requirements are issued to the applicant by your agency, copies should be forwarded to the Districts for our records. The approved plans consist of:

1. Drawing No. S-101: Title Sheet
2. Drawing No. S-102: General Site Plan
3. Drawing No. M-101: OU-1 Treatment System Overall Piping Plan
4. Drawing No. M-102: OU-1 Treatment System Plant Isometric
5. Drawing No. M-201& M-202: OU-1 Treatment System Piping Plan - East & West.
6. Drawing No. M-301 to M-303: OU-1 Treatment System Piping Elevation East & West and Piping Sections
7. Drawing No. M-401: OU-1 Treatment System Details
8. Drawing No. C-101: Foundation Plan and Detail
9. Drawing No. C-102 to C-103: Foundation Detail (for information only)
10. Drawing No. C-201, C-202, & C301: Piping Plan (for information only)
11. Drawing No. C-401: Sewer Line Plan and Details
12. Drawing No. C-501: Potable Water Line Plan (for information only)
13. Drawing No. PIDLA: Piping & Instrumentation Diagram Fluid Bed Reactor
14. Drawing No. PIDLB: Piping & Instrumentation Diagram Fluid Bed Reactor
15. Drawing No. PFD-1: Process Flow Diagram Fluid Bed Reactor System

Recycled Paper

16. Drawing No. PID-1: P&ID Extraction Wells
17. Drawing No. PID-2: P&ID Granular Activated Carbon System
18. Drawing No. PID-3: P&ID Fluid Bed Reactor System
19. Drawing No. PID-4: P&ID Aeration Tank
20. Drawing No. PID-5: P&ID Trimite Filter System
21. Drawing No. PID-6: P&ID Reinjection Wells (for information only)
22. Drawing No. PID-7: P&ID Chemical Feed Systems
23. Drawing No. PID-8: P&ID Backwash Recovery System

Approval of the addendum is subject to compliance with all applicable Ordinance requirements, upon any corrections shown in red on the drawings, and upon the items indicated on the attached requirement list. Failure to comply with all items on the requirement list invalidates this approval and issuance. Invalidation of this addendum may result in the applicant being deemed to be operating without a valid permit and subject to immediate discontinuance of sewer services for industrial operations.

If you have any questions concerning these requirements, please contact Alicia Barrera of the Districts' Industrial Waste Section at extension 2918.

Very truly yours,

James F. Stahl

Suzanne S. Wienke

Suzanne S. Wienke
Supervising Civil Engineer

SSW:AB

cc: Henry D. Koyamatsu
Jet Propulsion Laboratory
4800 Oak Grove Dr. MS200-203
Pasadena, CA 91109-8099

COUNTY SANITATION DISTRICTS OF LOS ANGELES COUNTY (DISTRICTS)

James F. Stahl, Chief Engineer and General Manager
1955 Workman Mill Road, P.O. Box 4998, Whittier, California 90607

INDUSTRIAL WASTEWATER DISCHARGE PERMIT

REQUIREMENT LIST

COMPANY NAME: Jet Propulsion Laboratory

INDUSTRIAL WASTEWATER DISCHARGE PERMIT NUMBER: 7024 R-2 Addendum

ACCOUNT NUMBER: 1710061

DATE OF APPROVAL: January 21, 2005

The above named company is required to comply with all indicated items on this list as a condition of the permit approval. Satisfactory evidence of compliance with these conditions should be supplied to the Districts where requested. Satisfactory evidence will consist of a minimum of written notification signed by a responsible company official, and in some cases may involve the submission of additional drawings and data, or verification by a Districts representative. Failure to comply with all items on the requirement list, including all deadlines specified, invalidates this approval and issuance of Industrial Wastewater Discharge Permit No. 7024 R-2. Invalidation of this permit will result in Jet Propulsion Laboratory being deemed to be operating without a valid permit and subject to immediate discontinuance of sewer services for industrial operations.

1. This approval is an addendum to Industrial Wastewater Discharge Permit No. 7024 R-2 issued on January 14, 1993.

2. Applicable requirements of the previously issued permit are still in force.

3. Previously approved plans are still valid, except as revised herein.

4. This addendum covers the installation of a groundwater pretreatment system and its associated wastewater discharge to the sewer from the backwash of new and spent GAC, the slurry transfer of new clean GAC, backwash of sand filter, FBR biomass recovery system, and rainfall within the contained groundwater pretreatment area.

5. This approval of the proposed groundwater pretreatment system by the Districts is for only the general concept presented. The proper construction, maintenance, and operation of the system is the responsibility of the permittee and his contractors.

6. The required sampling box red marked on the approved plans and its installation must conform to the I-12 County Engineer or 2044-0 County Department of Public Works (DPW) Standard enclosed with the applicant's copy. The sampling box must be constructed with a structurally sound material and raised above the surrounding grade to prevent rainwater intrusion to the sewer. An above ground sample box is also acceptable. It is the permittee's responsibility to adopt the proper precautions (e.g., double containment, coating, etc.) to prevent the contamination of the surrounding soil or groundwater.

7. The Districts shall be notified in writing, within 60 days from the date of this letter, as soon as the construction of the groundwater pretreatment system and sample box are complete, or if any construction changes are contemplated that substantially revise information given on previously approved plans.

8. The sample box required downstream of both batch groundwater discharge streams will be designated as **sampling location No. 907024** (to be located approximately directly north of clarifier tank, T-802). The 6" Parshall flume located inside the fenced southern end of the JPL facility is hereby designated as **sampling location No. 007024** and is the legal sampling point for surcharge reporting purposes and for determining compliance with EPA categorical pretreatment standards and the Districts' Phase I Limits for the subject facility. The permittee is responsible for maintaining and cleaning the sampling points to prevent any build-up of oil and grease, sediment or sludge; failure to do so does not invalidate sampling test results. Analytical results from samples taken from these locations according to accepted sampling procedures shall be accepted as binding. Safe and convenient access to the sampling points must be provided for representatives of the Districts. Should Districts' staff determine that the sampling locations are unsafe, difficult to access or require modification, the permittee must propose alternatives which will provide sampling facilities acceptable to the Districts.

9. The effluent discharge limits applicable at **sampling location No. 907024** for the volatile organic parameters (per EPA Test Methods 601 and 602, or 624) is 1 mg/L; for the semi-volatile organic parameters (per EPA Test Method 625) is 1 mg/L; and for 1,4 dioxane is 5 μg/l. Although the Districts have not set a specific limit on perchlorate for industrial wastewater dischargers, concentrations of perchlorate in excess of 0.82 mg/l will be considered excessive.

10. The Districts are required by law to enforce the Categorical Pretreatment Regulations established by the United States Environmental Protection Agency. Based on information submitted and verified by the Districts, the permittee is no longer required to comply with pretreatment standards for existing sources in the Metal Finishing Category (40 CFR 433) at the last stage of the clarifier for Building 170 due to the elimination of the chrome conversion coating operation. Based on information submitted to the Districts, the permittee may be subject to pretreatment standards for existing sources in the Metal Finishing Category (40 CFR 433) as well as the Electrical and Electronic Components EPA Category (40 CFR 469, Subpart A - Semiconductor). The Districts will determine the pretreatment standards applicable at the subject site in the forthcoming permit renewal approval currently under review. In the interim, the permittee is required to be in compliance with the pretreatment standards for existing sources in the Metal Finishing Category (40 CFR 433) at **sampling location No. 0007024**. The pretreatment standards are shown below. The permittee is advised that any discharge in excess of these standards requires corrective action by the discharger. Penalties applicable to violations of these limits will be strictly enforced by the Districts.

Pollutant	Daily Maximum (mg/l)	Monthly Average (mg/l)
Cadmium (T)	0.69	0.26
Chromium (T)	2.77	1.71
Copper (T)	3.38	2.07
Lead (T)	0.69	0.43
Nickel (T)	3.98	2.38
Silver (T)	0.43	0.24
Zinc (T)	2.61	1.48
Cyanide (T)	1.20	0.65
TTO	2.13	----

11. For industrial pollutants not regulated by the EPA regulation or where the EPA regulation is less stringent than those of the Districts, the Districts will continue to enforce its effluent limitations shown in the following list of "Industrial Wastewater Effluent Limitations," at **sampling location No. 0007024.** The subject EPA regulations do not authorize any violations of the Districts' regulations. The permittee is advised that any discharge in excess of these limits requires corrective action by the discharger.

SANITATION DISTRICTS OF LOS ANGELES COUNTY
INDUSTRIAL WASTEWATER LOCAL EFFLUENT LIMITATIONS
FOR JOINT OUTFALL DISTRICTS

PHASE I CONTROL PERIOD

Parameter	Limit (mg/l)*
Arsenic	3
Cadmium	15
Chromium (Total)	10
Copper	15
Lead	40
Mercury	2
Nickel	12
Silver	5
Zinc	25
Cyanide (Total)	10
Total Identifiable Chlorinated Hydrocarbons**	Essentially None

* - Maximum concentration at any time

** - Total Identifiable Chlorinated Hydrocarbons (TICH) comprise:
Aldrin and Dieldrin
Chlordane (cis & trans), trans-nonachlor, oxychlordane, heptachlor and heptachlor epoxide
DDT and derivatives: p, p', and o, p' isomers of DDT, DDD, and DDE
Endrin
HCH: sum of α, β, γ, δ isomers of hexachlorocyclohexane
Toxaphene
Polychlorinated biphenyls (PCB's)

12. Pre-Discharge Monitoring for the Performance Period

A. For the first months of operation, the permittee will be required to sample and analyze every batch of treated wastewater to verify that it will meet the Districts' discharge requirements, before discharge to the sewer.

B. After the groundwater storage tanks (T-802 and T-202) are filled, a representative sample shall be taken and analyzed by a certified lab. The samples analyzed must be tank composites. The samples must be analyzed for pH, chemical oxygen demand, total solids, suspended solids, volatile organic parameters (per EPA Test Methods 601 and 602), semi-volatile organic parameters (per EPA Test Method 625), perchlorate, and 1,4 dioxane. All analyses including those samples that do not meet the discharge limits, shall be kept on file in a location easily accessible for inspection by representatives of the Districts. The permittee is required to submit a complete summary of these analyses prior to each discharge event.

C. Once it is verified that the wastewater meets the Districts' effluent limitations, that batch of water can be discharged to the sewer. Contents in the batch tanks which do not meet the discharge limits must not be discharged to the sewer. This wastewater must be retreated and a new sample must be taken to ensure that the Districts' limits are met prior to discharge.

D. If the wastewater meets the effluent limitations consistently after the first months, the permittee may request in writing to have this pre-discharge monitoring requirement waived. Upon approval by the Districts, the permittee may cease pre-discharge monitoring. However, the batch discharge requirement outlined in item No. 13 below must still be fulfilled.

13. Pretreatment data for each batch of process solution discharged must be kept in a log book that must be made available for inspection by representatives of the Districts at any time during business hours. This log book must contain the following information:

A. The date and time a batch treatment begins
B. The type of treatment provided
C. The batch discharge tank ID number
D. The date and time a batch is discharged to the sewer
E. The volume of wastewater discharged
F. Initials of the operator with any comments on difficulties encountered during treatment

14. Operation, Maintenance and Calibration of the Groundwater Pretreatment System:

A. The permittee shall prepare and maintain up to date an Operation and Maintenance Manual of the pretreatment system for ready reference by company employees and Districts' representatives. Checklists for operation and maintenance for routine use should be developed (The manual does not need to be submitted for approval).

B. The permittee shall operate, maintain and calibrate the pretreatment system per the Operation and Maintenance Manual.

C. The permittee shall provide an adequate number of qualified personnel to operate and maintain the pretreatment system.

D. The permittee shall maintain a current operation and maintenance log at the control center of the pretreatment system. The log shall record all pretreatment system malfunctions, equipment failures, and other related information, and shall be properly dated and signed. The log shall be made accessible for inspection by Districts' representatives at all times.

E. The permittee shall maintain an adequate stock of replacement parts for key components of the pretreatment system, and an adequate supply of all pretreatment chemicals and other materials.

15. The permittee is advised that additional industrial wastewater pretreatment equipment may be required if inspection or monitoring indicates prohibited materials are discharged to the public sewer.

16. The discharge of high solids wastes which tend to create obstruction of flow problems in the sewer is prohibited. The permittee may be required to install a solids removal system if it is determined that the discharge from the groundwater pretreatment system causes obstruction problems in the District' sewerage system.

17. Under no circumstances shall process solution spills be discharged directly to the sewer. Unreclaimed or untreated process solution spills shall be hauled to a legal disposal site.

18. When spill containment walls or dikes are constructed on existing concrete or masonry, the contact mortar or concrete shall be bonded to the existing surface and all joints shall be sealed with acid resistant sealant or materials.

19. Any rainwater discharge to the sewer system must be in accordance with the Districts' *Guidelines For The Discharge Of Rainwater, Stormwater, Groundwater And Other Water Discharges*.

20. Impounded rainwater must only be discharged to the sewer two hours after the cessation of a rain event, at a flowrate not to exceed the permitted peak flowrate of 550 gallons per minute.

21. Self-monitoring of the industrial wastewater must be performed at the intervals indicated on the enclosed Self-Monitoring Requirements Forms for **sampling locations No. 007024 and No. 907024 and** reported on the Self-Monitoring Report (SMR) forms. The Districts will send the necessary SMR forms before each reporting period. All indicated analyses must be performed by a State or Districts' certified laboratory. The certification section of the SMR forms must be completed and signed by a responsible company official. For each reporting period, the completed SMR form and the corresponding laboratory report must be submitted to the Districts' Industrial Waste Section no later than the due date indicated on the form. The wastewater samples analyzed must be collected in such a way that they are representative of the total discharge generated by a typical day's operations. Each representative sample (composite and/or grab) should be collected over one 24-hour period and analyzed for all parameters in Table 1 of the Self-Monitoring Requirements form. All representative samples must meet all applicable limits. If the permittee is subject to EPA Categorical Pretreatment Standards, violations of

categorical effluent limitations must be reported to the Districts within 24 hours of the discharger becoming aware of the violation ((562) 699-7411, extension 2907). Additional sampling and analysis must be conducted for all categorical parameters in violation. The results of the repeat analysis must be submitted within 30 days of becoming aware of the violation. It is the responsibility of the permittee to submit results from any additional self-monitoring, and to notify the Districts of any other toxic materials which are known to be present in the wastewater.

22. The permittee is required to file a Long Form Surcharge Statement. Surcharge tests of the industrial wastewater must be performed at the intervals indicated on the enclosed table of Surcharge Test Frequency and submitted annually with the wastewater treatment surcharge statement. All samples taken for surcharge tests must be collected from **sampling location No. 007024** (the 6" Parshall flume). The permittee is reminded that the surcharge testing requirements are independent of the tests for self-monitoring reports required in Item No. 21.

23. In the event of the discharge of any prohibited waste, excessive quantities or concentrations of any restricted waste, or of the discharge of material not covered under this permit, the company must immediately notify the Districts by calling 562-699-7411, extension 2907, during office hours or the Long Beach Pumping Plant, 562-437-6520, during non-office hours.

    The Districts must also be notified of any circumstances affecting plant processes or facility operations that may potentially result in the discharge of similarly prohibited or restricted wastes, including but not limited to the malfunction, upset or improper operation of plant processes, pretreatment systems, spill containment facilities, or diversion/bypass mechanisms. Failure to immediately notify the Districts of any such event or condition is a violation of the Wastewater Ordinance.

24. The accompanying Sanitation Districts of Los Angeles County Industrial Wastewater Discharge Permit Fact Sheets **must** be visibly posted by the permittee near their respective legal sampling location points.

25. Every person or permittee violating any provision of this Industrial Wastewater Discharge Permit (permit) or the Districts' *Wastewater Ordinance* (*Ordinance*) is guilty of a misdemeanor, and upon conviction is punishable as provided by law (California Health & Safety Code Section 4766 currently allows for a fine not to exceed $1000, or imprisonment for not more than thirty (30) days, or both. Misdemeanor violations of California Health & Safety Code Section 25189.5 currently allow for a fine not to exceed $100,000 and imprisonment not to exceed one year. Misdemeanor violations of the Clean Water Act, 33 USC 1319(c) currently allow for a fine not to exceed $25,000 and imprisonment not to exceed one year.) Each day during which any violation continues shall constitute a separate offense. The Chief Engineer is authorized to seek, through the office of the District Attorney of Los Angeles County or other appropriate authority, prosecution of criminal charges against any person violating any provision of the permit or the Ordinance. Violations of discharge limitations established under this permit or the *Ordinance* may also be violations of state and federal environmental laws which may be punishable as felonies and which may also carry substantial fines and penalties (California Health & Safety Code 25189.5 currently allows for a fine not to exceed $100,000 (except the fine can be up to $250,000 for great bodily injury or substantial probability of death) and imprisonment up to 3 years and 33 USC Section 1319(c) currently allows for a fine not to exceed $1,000,000 for a first conviction and imprisonment of up to 15 years.)

In addition, any person or permittee who violates any provision of the *Ordinance* or any term or condition of any permit issued pursuant to the *Ordinance* or plan approval that prohibits or limits the discharge of any waste or imposes any pretreatment requirement shall be civilly liable to the Districts in the maximum sum provided by law for each day in which such violation occurs (California Government Code Section 54740 currently allows for civil penalties which include, but are not limited to, a fine of up to $25,000 per day of violation.)

26. The permittee shall maintain records of all information resulting from any monitoring activities required by 40 CFR 403.12, including self-monitoring reports and baseline monitoring reports. Such records shall include for all samples:

    A. The date, exact place, method, and time of sampling and the name of the person or persons taking the samples;
    B. The dates analyses were performed;
    C. Who performed the analyses;
    D. The analytical techniques/methods used; and
    E. The results of such analyses.

    The permittee is required to retain for a minimum of 4 years any records of monitoring activities and results (whether or not such monitoring activities are required by 40 CFR 403.12) and shall make such records available for inspection and copying by the Districts. This period of retention shall be extended during the course of any unresolved litigation regarding the permittee or when requested by the Districts.

27. In accordance with federal regulations found at 40 CFR Part 403.17, the permittee must not bypass required pretreatment equipment unless the bypass was unavoidable to prevent loss of life, personal injury or severe property damage and there were no feasible alternatives to the bypass and the permittee notified the Districts at least 10 days prior to an anticipated bypass or within 24 hours of an unanticipated bypass. Severe property damage does not include economic loss due to production delays. Feasible alternatives include use of auxiliary treatment facilities, retention of untreated wastes or cessation of production.

    The permittee shall submit oral notice of an unanticipated bypass that exceeds applicable categorical effluent limitations to the Districts within 24 hours from the time the permittee becomes aware of the bypass.

    A written submission shall also be provided within 5 days of the time that the permittee becomes aware of the bypass. The written submission shall contain a description of the bypass and its cause; the duration of the bypass, including exact dates and times, and, if the bypass has not been corrected, the anticipated time it is expected to continue; and steps taken or planned to reduce, eliminate, and prevent reoccurrence of the bypass. The Districts may waive the written report on a case-by-case basis if the oral report has been received within 24 hours.

    The Permittee may allow any bypass to occur which does not cause Pretreatment Standards or Requirements to be violated, but only if it also is for essential maintenance (i.e. pipe or pump failures) to assure efficient operation. However, routine maintenance should be conducted during normal periods of production downtime. Notification is not required for bypasses that do not result in federal categorical violations.

The Districts will determine whether the permittee has met all bypass criteria above thus avoiding enforcement action for violation of federal categorical regulations. However, this does not relieve a discharger of the responsibility to comply with Districts' *Ordinance* or effluent limitations at all times. Any repair or maintenance costs to Districts' facilities associated with any bypass of pretreatment equipment will be borne by the permittee.

28. Upon request by the Districts, the permittee is required to develop a Slug Discharge Control Plan which complies with the Districts' Spill Containment Guidelines and includes, at a minimum, the following elements:

    A. Description of discharge practices, including non-routine batch discharges (non-routine batch discharges are not allowed unless specified as an approved discharge in the permit);
    B. Description of stored chemicals;
    C. Procedures for immediately notifying the Districts of slug discharges, including any discharge that would violate a prohibition under 40 CFR 403.5(b), with procedures for follow-up written notification within five days;
    D. If necessary, procedures to prevent adverse impact from accidental spills, including inspection and maintenance of storage areas, handling and transfer of materials, loading operations, control of plant site run-off, worker training, building of containment structures or equipment, measures for containing toxic organic pollutants (including solvents), and/or measures and equipment for emergency response.
    E. This plan must be maintained at the discharge location and must be made available for review by Districts' personnel. Copies may be required to be submitted to the Districts for review.

29. The approval and issuance of this permit is contingent on and subject to compliance with all above items in this requirement list. Items Nos. 6 and 7 above must be satisfied within 60 days of the date of this approval.

SANITATION DISTRICTS OF LOS ANGELES COUNTY
INDUSTRIAL WASTE SECTION
P.O. BOX 4998
WHITTIER, CA 90607

SELF-MONITORING REQUIREMENTS

Significant Industrial User

Date	January 21, 2005	Sampling Location No.	007024
Firm Name	Jet Propulsion Laboratory	Account No.	1710061
Situs Address	4800 Oak Grove Dr.	District No.	16
	Pasadena, CA 91011	SIC No.	8733 3471
Contact Person	Henry D. Koyamatsu	Annual Flow (MGY)	47.31
Telephone No.	(818)354-2873		

Sampling Point: 6" Parshall flume located inside the fenced southwest end of the JPL facility

Self-monitoring of industrial wastewater is required as a condition of your industrial wastewater discharge permit. At the frequency specified below, samples must be collected and preserved in accordance with 40 CFR 136.

Frequency of Analysis - Once per six (6) months

Analysis of the samples must be performed for the parameters listed in Table 1 by a laboratory that is certified by either the Districts or the State Department of Health Services.

TABLE 1. REQUIRED WASTEWATER CHARACTERIZATION TESTS

Test Code	Test Parameter	Unit	Daily Max. Limit	Monthly Avg. Limit	Type of Sample
Z01	Total Wastewater Flowrate	gpd			Not Applicable
Z02	Peak Wastewater Flowrate	gpm	550		Not Applicable
403	Chemical Oxygen Demand (COD)	mg/l			24-hr Composite
151	Suspended Solids (SS)	mg/l			24-hr Composite
101	pH	pH units	≥6.0		Grab
252	Dissolved Sulfide	mg/l	0.1		Grab
708	Cadmium	mg/l	0.69	0.26	24-hr Composite
709	Chromium	mg/l	2.77	1.71	24-hr Composite

TABLE 1. REQUIRED WASTEWATER CHARACTERIZATION TESTS

Test Code	Test Parameter	Unit	Daily Max. Limit	Monthly Avg. Limit	Type of Sample
712	Copper	mg/l	3.38	2.07	24-hr Composite
714	Lead	mg/l	0.69	0.43	24-hr Composite
718	Nickel	mg/l	3.98	2.38	24-hr Composite
722	Silver	mg/l	0.43	0.24	24-hr Composite
724	Zinc	mg/l	2.61	1.48	24-hr Composite
206	Total Cyanide	mg/l	1.20	0.65	Grab
T06	Total Toxic Organics (TTO)[1]	ug/l	2130		Not Applicable[2]
601	Methylene chloride	ug/l			Grab
602	Chloroform	ug/l			Grab
603	1,1,1 - Trichloroethane	ug/l			Grab
604	Carbon tetrachloride	ug/l			Grab
605	1,1 - Dichloroethene	ug/l			Grab
606	Trichloroethylene	ug/l			Grab
607	Tetrachloroethylene	ug/l			Grab
608	Bromodichloromethane	ug/l			Grab
609	Dibromochloromethane	ug/l			Grab
610	Bromoform	ug/l			Grab
611	Chlorobenzene	ug/l			Grab
612	Vinyl chloride	ug/l			Grab
613	o - Dichlorobenzene	ug/l			Grab
614	m - Dichlorobenzene	ug/l			Grab
615	p - Dichlorobenzene	ug/l			Grab
616	1,1 - Dichloroethane	ug/l			Grab

[1] TTO is defined as the sum of the organics listed with test codes beginning with 5, 6 and 8 which are individually present at concentrations greater than 10 ug/l.

[2] Type of sample is specified for each organic compound included in the TTO listing.

TABLE 1. REQUIRED WASTEWATER CHARACTERIZATION TESTS

Test Code	Test Parameter	Unit	Daily Max. Limit	Monthly Avg. Limit	Type of Sample
618	1,1,2 - Trichloroethane	ug/l			Grab
619	1,2 - Dichloroethane	ug/l			Grab
620	Benzene	ug/l			Grab
621	Toluene	ug/l			Grab
624	Ethyl benzene	ug/l			Grab
645	Trans - 1,2 - dichloroethylene	ug/l			Grab
646	Bromomethane	ug/l			Grab
647	Chloroethane	ug/l			Grab
648	2 - Chloroethylvinylether	ug/l			Grab
649	Chloromethane	ug/l			Grab
650	1,2 - Dichloropropane	ug/l			Grab
651	Cis - 1,3 - dichloropropene	ug/l			Grab
652	Trans - 1,3 - dichloropropene	ug/l			Grab
653	1,1,2,2 - Tetrachloroethane	ug/l			Grab
654	Acrolein	ug/l			Grab
655	Acrylonitrile	ug/l			Grab
800	Acenaphthene	ug/l			Grab
801	Acenaphthylene	ug/l			Grab
802	Anthracene	ug/l			Grab
803	Benzidine	ug/l			Grab
804	1,2 - Benzanthracene	ug/l			Grab
805	Benzo (a) pyrene	ug/l			Grab
806	3,4 - Benzofluoroanthene	ug/l			Grab
807	1,12 - Benzoperylene	ug/l			Grab
808	11,12 - Benzofluoranthene	ug/l			Grab
809	Bis (2 - chloroethoxy) methane	ug/l			Grab

TABLE 1. REQUIRED WASTEWATER CHARACTERIZATION TESTS

Test Code	Test Parameter	Unit	Daily Max. Limit	Monthly Avg. Limit	Type of Sample
810	Bis (2 - chloroethyl) ether	ug/l			Grab
811	Bis (2 - chloroisopropyl) ether	ug/l			Grab
812	Bis (2 - ethylhexyl) phthalate	ug/l			Grab
813	4 - Bromophenyl phenyl ether	ug/l			Grab
814	Butyl benzyl phthalate	ug/l			Grab
815	2 - Chloronaphthalene	ug/l			Grab
816	4 - Chlorophenyl phenyl ether	ug/l			Grab
817	Chrysene	ug/l			Grab
818	1,2,5,6 - Dibenzanthracene	ug/l			Grab
822	3,3' - Dichlorobenzidine	ug/l			Grab
823	Diethyl phthalate	ug/l			Grab
824	Dimethyl phthalate	ug/l			Grab
825	Di - n - butyl phthalate	ug/l			Grab
826	2,4 - Dinitrotoluene	ug/l			Grab
827	2,6 - Dinitrotoluene	ug/l			Grab
828	Di - n - octyl phthlate	ug/l			Grab
829	1,2 - Diphenylhydrazine	ug/l			Grab
830	Fluoranthene	ug/l			Grab
831	Fluorene	ug/l			Grab
832	Hexachlorobenzene	ug/l			Grab
833	Hexachlorobutadiene	ug/l			Grab
834	Hexachlorocyclopentadiene	ug/l			Grab
835	Hexachloroethane	ug/l			Grab
836	Indeno (1,2,3 - c,d) pyrene	ug/l			Grab
837	Isophorone	ug/l			Grab
838	Naphthalene	ug/l			Grab

TABLE 1. REQUIRED WASTEWATER CHARACTERIZATION TESTS

Test Code	Test Parameter	Unit	Daily Max. Limit	Monthly Avg. Limit	Type of Sample
839	Nitrobenzene	ug/l			Grab
840	N-nitrosodimethylamine	ug/l			Grab
841	N-nitrosodi-n-propylamine	ug/l			Grab
842	Phenanthrene	ug/l			Grab
843	Pyrene	ug/l			Grab
845	2 - Chlorophenol	ug/l			Grab
846	1,2,4 - Trichlorobenzene	ug/l			Grab
847	2,4 - Dichlorophenol	ug/l			Grab
848	2,4 - Dimethylphenol	ug/l			Grab
849	2,4 - Dinitrophenol	ug/l			Grab
850	2 - Methyl - 4,6 - Dinitrophenol	ug/l			Grab
851	2 - Nitrophenol	ug/l			Grab
852	4 - Nitrophenol	ug/l			Grab
853	4 - Chloro - 3 - Methylphenol	ug/l			Grab
854	Pentachlorophenol	ug/l			Grab
855	Phenol	ug/l			Grab
856	2,4,6 - Trichlorophenol	ug/l			Grab
857	N - nitrosodiphenylamine	ug/l			Grab
502	4,4 - DDE	ug/l	0	0	Grab
504	4,4 - DDD	ug/l	0	0	Grab
506	4,4 - DDT	ug/l	0	0	Grab
508	Alpha - BHC	ug/l	0	0	Grab
509	Lindane (Gamma - BHC)	ug/l	0	0	Grab
510	Heptachlor	ug/l	0	0	Grab
511	Heptachlor epoxide	ug/l	0	0	Grab
512	Aldrin	ug/l	0	0	Grab

TABLE 1. REQUIRED WASTEWATER CHARACTERIZATION TESTS					
Test Code	**Test Parameter**	**Unit**	**Daily Max. Limit**	**Monthly Avg. Limit**	**Type of Sample**
513	Dieldrin	ug/l	0	0	Grab
514	Endrin	ug/l	0	0	Grab
515	Toxaphene	ug/l	0	0	Grab
519	PCB - 1242	ug/l	0	0	Grab
520	PCB - 1254	ug/l	0	0	Grab
523	Beta - BHC	ug/l	0	0	Grab
524	Delta - BHC	ug/l	0	0	Grab
530	Total Chlordane	ug/l	0	0	Grab
531	Alpha - endosulfan	ug/l			Grab
532	Beta - endosulfan	ug/l			Grab
533	Endosulfan sulfate	ug/l			Grab
534	Endrin aldehyde	ug/l			Grab
535	PCB - 1016	ug/l	0	0	Grab
536	PCB - 1221	ug/l	0	0	Grab
537	PCB - 1232	ug/l	0	0	Grab
538	PCB - 1248	ug/l	0	0	Grab
539	PCB - 1260	ug/l	0	0	Grab

Self-monitoring results must be reported on the Self-Monitoring Report form provided, along with the appropriate laboratory analysis sheet(s). Due dates are shown in Table 2.

TABLE 2. SELF-MONITORING REPORTING SCHEDULE[3]		
Analysis Frequency	**Reporting Period**	**Due Date[4]**
Once per 6 months	January 1 - June 30 July 1 - December 31	July 15 January 15
Once per 3 months	January 1 - March 31 April 1 - June 30 July 1 - September 30 October 1 - December 31	April 15 July 15 October 15 January 15
Once per month	Day 1 - Day 31 of the month	Day 15 of the next month

Industrial users participating in the Districts' Surcharge Program may be subject to additional self-monitoring requirements beside those specified above. Companies that file Long Form Surcharge Statements are required to monitor chemical oxygen demand (COD) and suspended solids (SS) at the frequency shown in Table 3.

TABLE 3. REQUIRED TESTING FREQUENCY FOR COD AND SS SURCHARGE PARAMETERS (24-hour composite samples only)	
Yearly Cumulative Flow from each Outlet (in million gallons)	**Required Testing Frequency**
Less than 15.00	1 sample per 3 months
15.01 to 40.00	1 sample per 2 months
40.01 to 100.00	2 samples per month
100.01 to 250.00	1 sample per week
More than 250.00	2 samples per week

Surcharge wastewater analyses must adequately represent the average daily discharge to the sewer system. Results must be submitted annually with the Surcharge Statement in accordance with each year's "Instructions for Filing a Long Form Wastewater Treatment Surcharge Statement".

[3]The laboratory data sheet(s) for each analysis performed during the reporting period must be included with the Self-monitoring Report form. However, only the results from the most recent sample collected during the reporting period should be on the Self-monitoring Report form.

[4] The Self-monitoring Report form may be submitted before the due date as long as the sample is taken during the appropriate reporting period.

SANITATION DISTRICTS OF LOS ANGELES COUNTY
INDUSTRIAL WASTE SECTION
P.O. BOX 4998
WHITTIER, CA 90607

SELF-MONITORING REQUIREMENTS

Significant Noncategorical Industrial User
Groundwater Pretreatment System

Date	January 21, 2005	Sampling Location No.	907024
Firm Name	Jet Propulsion Laboratory	Account No.	1710061
Situs Address	4800 Oak Grove Dr.	District No.	16
	Pasadena, CA 91011	SIC No.	8733 3471
Contact Person	Henry D. Koyamatsu	Annual Flow (MGY)	0.80
Telephone No.	(818) 354-2873		

Sampling Point: Standard I-12 sample box located immediately north of the clarifier, Tank T-802.

Self-monitoring of industrial wastewater is required as a condition of your industrial wastewater discharge permit. At the frequency specified below, samples must be collected and preserved in accordance with 40 CFR 136.

Frequency of Analysis - Once per six (6) months

Analysis of the samples must be performed for the parameters listed in Table 1 by a laboratory that is certified by either the Districts or the State Department of Health Services.

TABLE 1. REQUIRED WASTEWATER CHARACTERIZATION TESTS

TEST CODE	TEST PARAMETER	UNIT	LIMIT	TYPE OF SAMPLE
3B2	Perchlorate	mg/l	-	24-hour Composite
662	MTBE	ug/l	5	Grab
696	1,4 Dioxane	ug/l	5	Grab
T09	Volatile Organics[1]	ug/l	1,000	Not Applicable[2]

[1] Volatile and Semi Volatile Organics are defined as the sum of the organics listed with test codes beginning with 6 and 8, respectively, which are individually present at concentrations greater than 10 ug/l. These compounds are included in this list and must be monitored for as a minimum. Your company must report the presence of any additional regulated toxic organic compounds it believes to be present in the wastewater even if it is not listed on this form. Additionally, the Districts must be separately notified in writing that additional compounds are expected to be present in your wastewater and the reason for this change.

TABLE 1. REQUIRED WASTEWATER CHARACTERIZATION TESTS				
TEST CODE	TEST PARAMETER	UNIT	LIMIT	TYPE OF SAMPLE
601	Methylene chloride	ug/l		Grab
602	Chloroform	ug/l		Grab
603	1,1,1 - Trichloroethane	ug/l		Grab
604	Carbon tetrachloride	ug/l		Grab
605	1,1 - Dichloroethene	ug/l		Grab
606	Trichloroethylene	ug/l		Grab
607	Tetrachloroethylene	ug/l		Grab
608	Bromodichloromethane	ug/l		Grab
609	Dibromochloromethane	ug/l		Grab
610	Bromoform	ug/l		Grab
611	Chlorobenzene	ug/l		Grab
612	Vinyl chloride	ug/l		Grab
613	o - Dichlorobenzene	ug/l		Grab
614	m - Dichlorobenzene	ug/l		Grab
615	p - Dichlorobenzene	ug/l		Grab
616	1,1 - Dichloroethane	ug/l		Grab
618	1,1,2 - Trichloroethane	ug/l		Grab
619	1,2 - Dichloroethane	ug/l		Grab
620	Benzene	ug/l		Grab
621	Toluene	ug/l		Grab
624	Ethyl benzene	ug/l		Grab
645	Trans - 1,2 - dichloroethylene	ug/l		Grab
646	Bromomethane	ug/l		Grab

[2] Type of sample is specified for each organic compound included in the Volatile and Semi Volatile listing.

TABLE 1. REQUIRED WASTEWATER CHARACTERIZATION TESTS

TEST CODE	TEST PARAMETER	UNIT	LIMIT	TYPE OF SAMPLE
647	Chloroethane	ug/l		Grab
648	2 - Chloroethylvinylether	ug/l		Grab
649	Chloromethane	ug/l		Grab
650	1,2 - Dichloropropane	ug/l		Grab
651	Cis - 1,3 - dichloropropene	ug/l		Grab
652	Trans - 1,3 - dichloropropene	ug/l		Grab
653	1,1,2,2 - Tetrachloroethane	ug/l		Grab
T10	Semi Volatile Organics[1]	ug/l	1,000	Not Applicable[2]
800	Acenaphthene	ug/l		Grab
801	Acenaphthylene	ug/l		Grab
802	Anthracene	ug/l		Grab
803	Benzidine	ug/l		Grab
804	1,2 - Benzanthracene	ug/l		Grab
805	Benzo (a) pyrene	ug/l		Grab
806	3,4 - Benzofluoroanthene	ug/l		Grab
807	1,12 - Benzoperylene	ug/l		Grab
808	11,12 - Benzofluoranthene	ug/l		Grab
809	Bis (2 - chloroethoxy) methane	ug/l		Grab
810	Bis (2 - chloroethyl) ether	ug/l		Grab
811	Bis (2 - chloroisopropyl) ether	ug/l		Grab
812	Bis (2 - ethylhexyl) phthalate	ug/l		Grab
813	4 - Bromophenyl phenyl ether	ug/l		Grab
814	Butyl benzyl phthalate	ug/l		Grab
815	2 - Chloronaphthalene	ug/l		Grab
816	4 - Chlorophenyl phenyl ether	ug/l		Grab

TABLE 1. REQUIRED WASTEWATER CHARACTERIZATION TESTS				
TEST CODE	TEST PARAMETER	UNIT	LIMIT	TYPE OF SAMPLE
817	Chrysene	ug/l		Grab
818	1,2,5,6 - Dibenzanthracene	ug/l		Grab
822	3,3 - Dichlorobenzidene	ug/l		Grab
823	Diethyl phthalate	ug/l		Grab
824	Dimethyl phthalate	ug/l		Grab
825	Di - n - butyl phthalate	ug/l		Grab
826	2,4 - Dinitrotoluene	ug/l		Grab
827	2,6 - Dinitrotoluene	ug/l		Grab
828	Di - n - octyl phthlate	ug/l		Grab
829	1,2 - Diphenylhydrazine	ug/l		Grab
830	Fluoranthene	ug/l		Grab
831	Fluorene	ug/l		Grab
832	Hexachlorobenzene	ug/l		Grab
833	Hexachlorobutadiene	ug/l		Grab
834	Hexachlorocyclopentadiene	ug/l		Grab
835	Hexachloroethane	ug/l		Grab
836	Indeno (1,2,3 - c,d) pyrene	ug/l		Grab
837	Isophorone	ug/l		Grab
838	Naphthalene	ug/l		Grab
839	Nitrobenzene	ug/l		Grab
840	N-nitrosodimethylamine	ug/l		Grab
841	N-nitrosodi-n-propylamine	ug/l		Grab
842	Phenanthrene	ug/l		Grab
843	Pyrene	ug/l		Grab
845	2 - Chlorophenol	ug/l		Grab

TABLE 1. REQUIRED WASTEWATER CHARACTERIZATION TESTS				
TEST CODE	TEST PARAMETER	UNIT	LIMIT	TYPE OF SAMPLE
846	1,2,4 - Trichlorobenzene	ug/l		Grab
847	2,4 - Dichlorophenol	ug/l		Grab
848	2,4 - Dimethylphenol	ug/l		Grab
849	2,4 - Dinitrophenol	ug/l		Grab
850	2 - Methyl - 4,6 - Dinitrophenol	ug/l		Grab
851	2 - Nitrophenol	ug/l		Grab
852	4 - Nitrophenol	ug/l		Grab
853	4 - Chloro - 3 - Methylphenol	ug/l		Grab
854	Pentachlorophenol	ug/l		Grab
855	Phenol	ug/l		Grab
856	2,4,6 - Trichlorophenol	ug/l		Grab
857	N - nitrosodiphenylamine	ug/l		Grab

Self-monitoring results must be reported on the Self-Monitoring Report form provided, along with the appropriate laboratory analysis sheet(s). Due dates are shown in Table 2.

TABLE 2:
SELF-MONITORING REPORTING SCHEDULE[3]

Analysis Frequency	Reporting Period	Due Date[4]
Once per year	July 1 - June 30	July 15 (the following year)
Once per 6 months	January 1 - June 30 July 1 - December 31	July 15 January 15
Once per 3 months	January 1 - March 31 April 1 - June 30 July 1 - September 30 October 1 - December 31	April 15 July 15 October 15 January 15
Once per month	Day 1 - Day 31 of the month	Day 15 (the following month)

[3] The laboratory data sheet(s) for each analysis performed during the reporting period must be included with the Self-monitoring Report form. However, only the results from the most recent sample collected during the reporting period should be recorded on the Self-monitoring Report form.

[4] The Self-monitoring Report form may be submitted before the due date as long as the sample is taken during the appropriate reporting period.

SURCHARGE TEST REQUIREMENTS

Industrial users participating in the Sanitation Districts' Surcharge Program may be subject to additional self-monitoring requirements besides those specified in the permit conditions. Surcharge testing parameters include Chemical Oxygen Demand (COD) and suspended solids (SS). For companies that file Long Form Surcharge Statements, the testing frequency for COD and SS is based on flow as shown in Table 3 below. Surcharge wastewater analyses must adequately represent the average daily discharge to the sewer system and the results must be submitted annually with the wastewater treatment surcharge statement in accordance with each year's "Instruction for Filing a Long Form Wastewater Treatment Surcharge Statement." **Surcharge test requirements are independent of the self-monitoring report requirements.**

TABLE 3:
SURCHARGE TESTING FREQUENCY FOR COD AND SS
(Must be 24-hour Composite Samples)

Yearly Cumulative Flow from Each Outlet (in million gallons)	Required Testing Frequency
Less than 15.00	1 sample per 3 months
15.01 to 40.00	1 sample per 2 months
40.01 to 100.00	2 samples per month
100.01 to 250.00	1 sample per week
More than 250.00	2 samples per week

SANITATION DISTRICTS OF LOS ANGELES COUNTY
INDUSTRIAL WASTEWATER DISCHARGE PERMIT FACT SHEET

This fact sheet MUST be visibly posted by the discharger near the legal sampling point No. 907024.

COMPANY NAME	Jet Propulsion Laboratory	**I.W. NO.**	907024
SITUS ADDRESS	4800 Oak Grove Dr. Pasadena, CA 91011	**SURCH. ACCT.**	1710061
MAILING ADDRESS	4800 Oak Grove Dr. MS200-203 Pasadena, CA 91109-8099	**DISTRICT NO.**	16
TAX ASSESSOR NO.	5817-025-901	**TG**	535/E4
COMPANY CONTACT	Henry D. Koyamatsu	**TELEPHONE NO.**	(818)354-2873
OTHER PERMITS AT SITUS	None		
APPROVAL DATE	January 21, 2005		
EVALUATION ENGINEER	Alicia Barrera	**LOCAL AGENCY**	City of Pasadena
LOCATION OF CONNECTION TO PUBLIC SEWER	Local sewer on Oak Grove Dr.		
DISTRICTS' MANHOLE NO.	28-0001	**TREATMENT PLANT**	02 - Whittier Narrows WRP
TYPE OF INDUSTRY	Space Science Research & Development		
SIC NO(S).	8733 3471		
EPA CATEGORY	Noncategorical		
HOURS OF OPERATION/DAY	0000 to 2400	**OPERATING DAYS/WEEK**	7
TIME OF DISCHARGE IF DIFFERENT FROM ABOVE		**NUMBER OF EMPLOYEES**	N/A
AVERAGE FLOWRATE	18,600 gpd	**PEAK FLOWRATE**	25 gpm
PRODUCTS PRODUCED AT SITUS	N/A		
RAW MATERIAL USED AT SITUS	Groundwater and treatment chemicals.		
APPROVED WASTEWATER PRODUCING OPERATIONS	Backwash of new and spent GAC, slurry transfer of new clean GAC, backwash of sand filter, FBR biomass recovery system, and rainfall within the contained groundwater pretreatment area.		
CONSTITUENTS OF WASTEWATER	Suspended solids, oxygen demand, and trace metals, perchlorate and toxic organics.		
LEGAL SAMPLING POINT No. 907024	Standard I-12 sample box located immediately north of the clarifier, Tank T-802.		
IS SELF-MONITORING REQUIRED?	Yes	If yes, SMR requirements must be attached.	
REQUIRED PRETREATMENT/ EQUIPMENT	Granular activated carbon (GAC) units, biological degredation of perchlorate in fluidized bed reactor (FBR), aeration tank, multimedia sand filter, and clarifier.		
REQUIRED MONITORING EQUIPMENT	N/A.		
COMPANY SPECIFIC PERMIT CONDITIONS	Permittee must maintain a batch discharge log book and comply with start-up sampling and notification requirements as detailed in the addendum requirement list.		

IN THE EVENT OF THE DISCHARGE OF PROHIBITED OR RESTRICTED WASTES, PLEASE CALL:
OFFICE HRS: 562-699-7411, EXTENSION 2907; NON-OFFICE HOURS: 562-437-6520

SANITATION DISTRICTS OF LOS ANGELES COUNTY
INDUSTRIAL WASTEWATER DISCHARGE PERMIT FACT SHEET

This fact sheet MUST be visibly posted by the discharger near the legal sampling point.

COMPANY NAME	Jet Propulsion Laboratory		**I.W. NO.**	7024 R-2
SITUS ADDRESS	4800 Oak Grove Dr. Pasadena, CA 91011		**SURCH. ACCT.**	1710061
MAILING ADDRESS	4800 Oak Grove Dr. MS200-203 Pasadena, CA 91109-8099		**DISTRICT NO.**	16
TAX ASSESSOR NO.	5817-025-901		**TG**	535/E4
COMPANY CONTACT	Henry D. Koyamatsu	**TELEPHONE NO.**	(818)354-2873	
OTHER PERMITS AT SITUS	None			
APPROVAL DATE	January 21, 2005			
EVALUATION ENGINEER	Alicia Barrera	**LOCAL AGENCY**	City of Pasadena	
LOCATION OF CONNECTION TO PUBLIC SEWER	Local sewer on Oak Grove Dr.			
DISTRICTS' MANHOLE NO.	28-0001	**TREATMENT PLANT**	02 - Whittier Narrows WRP	
TYPE OF INDUSTRY	Space Science Research & Development			
SIC NO(S).	8733 3471			
EPA CATEGORY	40 CFR 433			
HOURS OF OPERATION/DAY	0000 to 2400	**OPERATING DAYS/WEEK**	7	
TIME OF DISCHARGE IF DIFFERENT FROM ABOVE		**NUMBER OF EMPLOYEES**	5800	
PERMIT FLOWRATE	208,178 gpd	**PEAK FLOWRATE**	550 gpm	
PRODUCTS PRODUCED AT SITUS	N/A			
RAW MATERIAL USED AT SITUS	Various metals, substrates, and chemicals.			
APPROVED WASTEWATER PRODUCING OPERATIONS	Alkaline cleaning of PCB's and metal parts, aqueous cleaning of metal parts, RO reject, water jet cutter, car/truck wash pad, film processing rinse, slurry waste from grinding epoxy, wafer processing wet scrubber, groundwater treatment system, chiller and cooling tower bleed-off			
CONSTITUENTS OF WASTEWATER	Dissolved and suspended solids, trace metals and toxic organics			
LEGAL SAMPLING POINT No. 007024	The 6" Parshall flume located inside the fenced southwest end of the JPL facility			
IS SELF-MONITORING REQUIRED?	Yes	If yes, SMR requirements must be attached.		
REQUIRED PRETREATMENT/ EQUIPMENT	Clarifiers and groundwater pretreatment system			
REQUIRED MONITORING EQUIPMENT	Effluent flow measurement system (6" Parshall flume)			
COMPANY SPECIFIC PERMIT CONDITIONS	None.			

IN THE EVENT OF THE DISCHARGE OF PROHIBITED OR RESTRICTED WASTES, PLEASE CALL:
OFFICE HRS: 562-699-7411, EXTENSION 2907; NON-OFFICE HOURS: 562-437-6520