**Site-Specific Health and Safety Plan for Work
Activities at the Natural and Accelerated
Bioremediation Research (NABIR) Field Research
Center (FRC), Oak Ridge, Tennessee**

D. B. Watson
H. D. Quarles

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D. B. Watson
Environmental Sciences Division
Oak Ridge National Laboratory
Field Research Center Manager

H. D. Quarles
Environmental Sciences Division
Oak Ridge National Laboratory
Field Research Center Regulatory Specialist

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REVIEWED/APPROVED BY:

Greg Rowland
Greg Rowland
ORNL HAZWOPER Program Coordinator

8/30/00
Date

Mary Anna Bogle
Mary Anna Bogle
Site Safety and Health Officer

8/30/00
Date

David B. Watson
David B. Watson
FRC Manager

8/24/00
Date

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ACRONYMS

BY/BY	Bone Yard/Burn Yard
CFR	Code of Federal Regulations
DOE	Department of Energy
ESD	Environmental Sciences Division
ESH&Q	Environmental Safety, Health, and Quality
FRC	Field Research Center
ISMS	Integrated Safety Management Systems
HASP	Health and Safety Plan
LSS	Laboratory Shift Superintendent
MSDS	Material Safety Data Sheet
NABIR	Natural and Accelerated Bioremediation Research
ORNL	Oak Ridge National Laboratory
ORR	Oak Ridge Reservation
OSHA	Occupational Safety and Health Act
PPE	Personal Protective Equipment
PSS	Plant Shift Superintendent
RWP	Radiological Work Permit
SSHO	Site Safety & Health Officer
VOC	volatile organic compound
WSS	Work Smart Standards

FOREWORD

The Occupational Safety and Health Act (OSHA) implementing regulations of 29 CFR 1910.120 govern hazardous waste operations and emergency response. These regulations require that employers of employees involved in certain specific hazardous waste operations 1) develop and implement a written safety and health PROGRAM for employees involved in hazardous waste operations, and 2) that the PROGRAM incorporate a site-specific safety and health plan.

Oak Ridge National Laboratory (ORNL) has employees conducting activities which fall within the scope of these regulations, and thus, has in place a written safety and health PROGRAM as required. Its contents are contained in the ORNL HAZWOPER Program Manual. Some activities conducted at the contaminated portion of the Natural and Accelerated Bioremediation Research Program's Field Research Center may fall within the scope of these OSHA regulations. Thus, to assure regulatory compliance, this site-specific safety and health plan covering activities conducted at the contaminated portion of the Field Research Center has been prepared. The Integrated Safety Management System and Environmental Safety, Health, and Quality check lists will be used to define safe work procedures for work conducted in uncontaminated areas of the Field Research Center.

The regulatory requirements for site-specific safety and health plans are found at 29 CFR 1910.120 (b)(4) and include ten specific elements which are designated with the letters A through J. Each of these elements is addressed in this safety and health plan for the Field Research Center. Each element is listed below along with the section number where it is addressed in this safety and health plan.

SAFETY AND HEALTH PLAN ELEMENT	SECTION NO. IN THIS PLAN
A) Safety and health risk hazard analysis	4.
B) Employee training assignments and requirements	6.1
C) Personal protective equipment requirements	4., 5.4
D) Medical surveillance requirements	6.2
E) Frequency and types of monitoring required	4., 5.2
F) Site control measures	5.3
G) Decontamination procedures	4., 5.6
H) Emergency response plan	5.7
I) Confined space entry procedures	none (no confined space entry)
J) Spill containment program	5.3

1. INTRODUCTION AND PROJECT DESCRIPTION

1.1. INTRODUCTION

The Environmental Sciences Division (ESD) at the Oak Ridge National Laboratory (ORNL) has established a Field Research Center (FRC) on the U.S. Department of Energy (DOE) Oak Ridge Reservation (ORR) in Oak Ridge, Tennessee for the DOE Headquarters Office of Biological and Environmental Research. The FRC provides a site for investigators in the Natural and Accelerated Bioremediation Research (NABIR) program to conduct research and obtain samples related to *in situ* bioremediation. The NABIR program is a ten-year program designed to increase the understanding of fundamental biogeochemical approaches for cleaning up DOE's contaminated legacy waste sites. The FRC is integrated with existing and future laboratory and field research and provides a means of examining the biogeochemical processes that influence bioremediation under controlled, small-scale field conditions.

The FRC lies within the Y-12 Plant area of responsibility on the Oak Ridge Reservation (Fig. 1.1). The Y-12 Plant is located in Bear Creek Valley adjacent to the City of Oak Ridge.

The FRC includes a 243-acre (98-ha), previously disturbed contaminated area to be used for conducting experiments on a plume of contaminated groundwater. The FRC also includes a 404-acre (163-ha) background area (Fig. 1.1), which provides for comparison studies in an uncontaminated area, and ancillary structures located within a 3.2 -mile (5.2-km) radius of each other on the Oak Ridge Reservation. The FRC contaminated field site includes the commingled groundwater plume found in the shallow unconsolidated sediments (<10 m depth), Nolichucky Shale, and Maynardville Limestone that originated from a combination of the S-3 Waste Disposal Ponds and the Bone Yard/Burn Yard (BY/BY). However, the initial focus of NABIR investigations is on the easily accessible shallow unconsolidated sediments that overlie the Nolichucky Shale. Contaminants in this plume and in the shallow saturated and unsaturated soils include uranium, Tc-99, strontium metal, nitrate, barium, cadmium, volatile organic contaminants (VOCs) and other inorganics and radionuclides believed to be of interest to the NABIR investigators.

The overall procedures for conducting research at the FRC and ensuring regulatory compliance are outlined in the FRC Management Plan. This Site-Specific Health and Safety Plan (HASP) addresses the safety aspects of the spectrum of work activities conducted at the contaminated area of the FRC. The work will be conducted as a series of individual projects by various principal investigators (PIs) from academia, national laboratories, industry, and federal agencies that have been selected to participate in the NABIR Program. FRC research activities are supported by ORNL ESD personnel, and associated ORNL environmental, safety, and health support groups. Activities at the contaminated area (but not the uncontaminated background area) fall under the scope of Code of Federal Regulations, 29 CFR 1910.120, *Hazardous Waste Operations and Emergency Response (HAZWOPER)*. The purpose of this document is to establish overall site-specific health and safety guidelines to be followed by all personnel conducting work at the FRC, regardless of organizational affiliation. Work will be performed in accordance with requirements, as stipulated, in the ORNL HAZWOPER Program Manual and applicable ORNL, UT-Battelle, and DOE policies and procedures. This HASP serves as an extension of the ORNL HAZWOPER Program Manual, which, combined with the FRC Management Plan, fulfills the requirements of 29 CFR 1910.120.

ORNL strongly emphasizes worker health and safety. Therefore, in addition to the requirements of this HASP, specific environment, safety, health, and quality (ESH&Q) reviews are conducted for each individual project proposed for the FRC using the Integrated Safety Management System (ISMS) process. These reviews highlight the specific safety requirements applicable to each project based on its location and project activities. ISMS reviews result in mandatory project-specific ESH&Q requirements lists, which apply to activities conducted not only at the contaminated area of the FRC (covered by this HASP), but in the uncontaminated background area as well (see FRC Management Plan). Thus, all activities at the FRC are conducted in accordance with ORNL Health and Safety Directives.

The levels of protection and procedures specified in this HASP are based on the best information available from historical data and recent evaluations of the area. Therefore, these recommendations represent the minimum health and safety requirements to be observed by all personnel engaged in work at the FRC. Unforeseeable site conditions, changes in scope of work, or hazardous conditions not previously considered will warrant a reassessment of the protection levels and controls stated. Refer to Sect. 5.1 for requirements pertaining to field modifications and changes to the HASP.

1.2. DESCRIPTION OF ACTIVITIES CONDUCTED ON THE FRC

The FRC supports four broad types of activities:

1. **Sample acquisition:** Source of subsurface samples for use by NABIR investigators.
2. **Intrinsic bioremediation analyses:** Characterization and analysis of the key subsurface features, processes, and conditions that support intrinsic bioremediation.
3. **Accelerated bioremediation research:** In situ experimental research on fundamental mechanisms to accelerate bioremediation.
4. **Assessment (field-based evaluation) research:** *In situ* evaluation of new methods for characterizing, monitoring and predicting the effectiveness of bioremediation.

Implementing these activities at the FRC involves:

- Installation of groundwater wells and coring
 - Drilling (e.g., air rotary, coring, push-probes, hollow-stem auger, sonic)
- Hydrogeologic characterization
 - Hydraulic testing (e.g., pumping tests, slug tests, point dilution tests)
- Geophysical testing
 - Seismic, neutron, electrical, gamma, sonic, ground penetrating radar, etc.
- Microbiology & geochemistry
 - Groundwater and core samples
 - Sampling for other investigators
 - Sample preservation in the field (e.g., chemical fixing, freezing with liquid nitrogen)

- **Biogeochemistry**
 - Groundwater and core samples under controlled atmosphere conditions
 - Sample storage and shipment (on & off site)
- **Manipulative tests**
 - Addition of nutrients (carbon, nitrogen, phosphorous, methane, hydrogen, etc.) for biostimulation
 - Addition of chemical stimulants for immobilization of contaminants
- **Bacterial Transport Research & Development - Bioaugmentation**
 - Enrichments of indigenous, naturally occurring organisms
 - Enrichments of non-indigenous naturally occurring organisms

2. SITE ORGANIZATION AND COORDINATION

FRC research activities will be performed by PIs and field project personnel with various affiliations, and by ESD personnel. All work is performed under the direction of the FRC Manager and support staff, all of whom are ESD employees. Appropriate health and safety services including additional monitoring and oversight are provided by the ORNL Office of Safety and Health Protection, and Office of Radiation Protection.

The following section describes the organizational structure of the FRC. Key personnel and their responsibilities are listed. Mr. David Watson is the FRC Manager and Ms. Mary Anna Bogle will serve as the Site Safety and Health Officer (SSHO). Mr. Norman Farrow is the alternate SSHO; Mr. Kirk Hyder will act as the SSHO designee in their absence.

2.1. SITE SAFETY AND HEALTH OFFICER

The SSHO advises the FRC Manager on safety and health issues and conducts briefings prior to initiation of site activities. The SSHO assesses the potential for worker exposures to hazardous agents, recommends appropriate hazard controls for protection of task site personnel, and will require personnel to obtain immediate medical attention in the event of a work-related injury or illness. The SSHO ensures any necessary monitoring of potential chemical hazards is performed, reviews the effectiveness of monitoring and personal protective equipment, and recommends upgrades or downgrades in protective safety and health measures. The SSHO ensures that appropriate fall protection measures are available and that needed work permits such as Radiological Work Permits (RWPs) are obtained. The SSHO notifies the Office of Radiation Protection when radiological support is required. The SSHO has stop work authority and advises emergency response personnel of an emergency and contacts the Plant Shift Superintendent's Office (PSS) when stop work conditions exist due to suspected health and safety hazard(s). The SSHO authorizes the return to work following resolution of any safety and health hazards or other stop work issues. The SSHO ensures that this HASP is revised and approved if there are changes in site conditions or tasks. The SSHO shall be available for consultation when required and shall be aware of project-related work occurring on-site.

2.2. FRC MANAGER

The FRC Manager has primary responsibility for directing and managing all FRC activities, including coordination with Bechtel Jacobs Company (the Environmental Management contractor) and Y-12 support organizations. The FRC Manager ensures that all on-site project personnel meet the required level of training, have reviewed the HASP, and are instructed in safe work practices. The FRC Manager also ensures that a qualified SSHO is designated, maintains a current copy of the HASP, and documents field changes to the HASP in the project logbook. In addition, the FRC Manager and staff perform oversight of field activities, maintain awareness of site operations, and ensure that all project personnel adhere to ES&H requirements in order to prevent potential accidents from occurring.

The FRC Manager is responsible for ensuring that the following five core functions of the Integrated Safety Management System are fulfilled appropriately:

- Define the work, roles and responsibilities. Allocate resources to ensure that research goals are balanced with safe work practices.
- Identify and analyze the hazards using the ESH&Q evaluation, consultation with subject matter experts, material safety data sheet information, Work Smart Standards (WSS), lessons learned by other PIs and staff, and other resources.
- Develop and implement hazard controls tailored to the work being performed.
 - Resources include NABIR and FRC staff, ORNL Work Smart Standards, subject matter experts, the Hazardous Materials Inventory System, ESD Chemical Hygiene Plan, Division and project procedures, Training Needs Assessment process, Laboratory Operating Manuals, Laboratory Stewards, ESD ESH&Q staff, and Lessons Learned and Alerts.
 - Examples of actions and tools include optimization of engineering controls and procedural approaches with training, HAZCOM job-specific training, job pre-briefings, compliance-based and project-specific training, ES&H permits (e.g., RWP, Lockout/Tagout process), and protective equipment.
- Perform work within controls to ensure the work is done safely:
 - Communicate expectations to project staff
 - Ensure that the controls identified in the ESH&Q evaluation and this HASP are carried out
 - Ensure opportunity for procedure modification to respond to unanticipated situations
 - Stop work if imminent danger exists
- Provide feedback and continuous improvement:
 - Solicit feedback from project staff regarding ESH&Q issues and act on that input
 - Communicate concerns to and seek help from supervisors and the ESH&Q group
 - Reallocate resources to address issues that arise
 - Ensure safety meetings and site briefings are performed

2.3. PRINCIPAL INVESTIGATORS AND FIELD PROJECT PERSONNEL

PIs and field project personnel involved in onsite operations are responsible for understanding the intent of the principles of Integrated Safety Management and are to be knowledgeable of the processes in place to satisfy the intent of Integrated Safety Management.

Define the Scope of Work

- Understand the expectations they are to meet in their particular work assignment
- Understand the responsibilities of the FRC Manager and SSO
- Provide documentation of training to the FRC Manager

Identify and Analyze the Hazard

- Notify the SSHO of any special medical conditions (i.e., allergies, diabetes, etc.)
- Actively participate in identification of hazards prior to beginning work
- Ensure that potential work hazards have been evaluated by subject matter experts and are accounted for in all work practices

Develop and Implement Hazard Controls

- Seek the help of the SSHO, ESD's ESH&Q staff, and other subject matter experts, as appropriate, to analyze the hazards
- Ensure that control strategies are developed and implemented, as appropriate, before work begins
- Ensure safety measures are incorporated into activities (i.e., through HASP addendums or amendments, work aides, or standard operating procedures)

Perform Work Within Controls

- Perform only those tasks that they believe they can do safely
- Meet the responsibilities and safely perform the tasks that are delegated to them
- Take all reasonable precautions to prevent injury to themselves and to their fellow employees; be alert to potentially harmful situations
- Suspend work if unexpected concerns arise and modify plans to address concerns before resuming work
- Comply with the work plan and HASP as well as postings and rules at the project site

Provide Feedback and Continuous Improvement

- Keep the SSHO and FRC Manager informed of any issues, problems, or concerns regarding all aspects of their work
- Notify appropriate facility management personnel or the facility point of contact of any unsafe condition, violation, noncompliance, or environmental threat discovered in a facility
- Report to the SSHO any changes in site conditions that may affect safety and health
- Immediately notify the SSHO of symptoms or signs of exposure potentially related to any chemical, physical, or biological hazards present at the site and immediately report any accidents, injuries, and/or unsafe conditions to the SSHO
- If unsafe conditions develop, task site personnel are authorized and expected to stop work and notify the SSHO and FRC Manager of the unsafe condition.

2.4. RADIATION PROTECTION

The ORNL Office of Radiation Protection will be responsible for oversight and approval of personal protection requirements related to radiation protection. A Radiation Protection representative will be contacted for all radiological concerns at the site. Relevant directives include ORNL Radiation Protection Program, RP-110, *ORNL Radiological Control Policy and the ORNL Radiological Protection Procedures*, and 10 CFR 835, *Occupational Radiation Protection*.

3. INTEGRATED SAFETY MANAGEMENT SYSTEM

The ISMS process systematically integrates safety into management and work practices at all levels so missions are accomplished while protecting the public, the worker, and the environment. Direct involvement of workers during the development and implementation of safety management systems is essential for success. DOE requires that the principles of ISMS be implemented for all ORNL activities. Therefore, all FRC personnel are expected to incorporate the following basic ISMS core functions during all work activities:

- Defining the scope of work;
- Identifying and analyzing hazards associated with the work;
- Developing and implementing hazard controls;
- Performing work activities within these controls; and
- Providing feedback on the adequacy of the controls to continue improving safety management.

4. TASK SPECIFIC HAZARD EVALUATION AND CONTROLS

The purpose of this FRC hazard evaluation is to identify and assess potential hazards that personnel might encounter and to prescribe methods of hazard control. Data tables A-1, A-2, and A-3 in Attachment A give the results of chemical and radiological contaminant analyses in soils, groundwater, and surface water at representative locations within the FRC contaminated areas. Material Safety Data Sheets (MSDS) for chemicals that are likely to be handled when conducting field work are included in Attachment B.

A description of sampling procedures and the activities to be conducted at the FRC is described below, and is also provided in greater detail in the NABIR FRC Site Characterization Plan and FRC Management Plan.

4.1. FIELD SAMPLING AND ANALYSIS OF GROUNDWATER

Task Description: Procedures for field sampling and analysis of groundwater are described in the FRC Site Characterization Plan. Groundwater will generally be sampled with a peristaltic pump. Slow purge techniques will be used in order to reduce the disturbance caused by removal of large volumes of water from the system. Field parameters will be monitored until stable groundwater chemistry (e.g. specific conductance, pH, Eh, temperature, dissolved oxygen) readings are obtained on the YSI Sonde. The YSI Sonde will be fitted with a flow-through cell to reduce exposure to the atmosphere. The purge water will be collected in 55-gallon drums and removed by the environmental management contractor, Bechtel Jacobs Company. It may also be possible to discharge water back to the subsurface if approved by the regulators.

Samples will be handled and transported according to regulatory requirements and procedures outlined in the FRC Storage and Data Management Plan, and the FRC Management Plan. Samples will be preserved and stored as required by the analytical protocols (e.g. cooled, preservative added) and FRC health-physicists will check for exterior radioactivity. Storage on site may occur for short periods of time in ice chests containing "blue ice" but will be quickly transferred to refrigerator storage at the laboratory at the appropriate temperatures. All storage of contaminated samples will follow procedures and regulations relevant to radioactive materials. Special handling procedures may be required to maintain anoxic sterile conditions for some microbial samples collected.

Equipment and Materials: Sampling equipment includes sampling tube (remains in the monitoring wells); peristaltic pump; a YSI multi-probe flow cell (for measuring water field parameters); filters and sample containers (for collecting samples); HACH meter and test kits and reagents for analyzing sulfur, ferrous iron, nitrite/nitrate, dissolved oxygen, and carbonate (see Appendix B for reagent MSDSs). Some samples will be preserved with a few drops of nitric, hydrochloric or sulfuric acid or formaldehyde. Calibration standards including pH and conductivity are also used. Stand-alone probes will be used for soil gross radioactive screening, downhole uranium analysis, pH, Eh, and groundwater specific conductance measurements. Compressed gas cylinders filled with nitrogen, argon, or other inert gases may be used to flush the void space in sample containers of oxygen prior to and/or after sampling.

Task Hazards and Controls:

- **Chemical and Radiological Hazards**

- Groundwater Contact: Based on previously obtained sample data, the risk of chemical or radiological exposure from short-term exposure to groundwater and surface water samples is minimal (Tables A-1, A-2, and A-3 give the results of chemical and radiological contaminant analyses in soils, groundwater, and surface water at representative locations within the FRC contaminated areas). However, direct contact with contaminated materials should be avoided, therefore, disposable latex or nitrile gloves and safety glasses will be worn when conducting groundwater sampling to prevent eye and skin contact.
- Reagent Contact: Corrosive or oxidizing reagents pose a contact hazard. To prevent eye and skin contact when corrosive or oxidizing reagents are used disposable latex or nitrile gloves and safety glasses will be worn.

- **Physical Hazards**

- Compressed gas cylinders: Rules and practices for handling compressed gas cylinders can be found at http://www-internal1.ornl.gov/oshp/nec_suff/gasinfo.htm.
- Tripping/Falling: Precautions should be taken to avoid trip, slip, and fall accidents when climbing irregular or slippery surfaces. Before changing location visually survey the area for slippery surfaces and tripping hazards.
- Heat/Cold Stress: Wear clothing appropriate for environmental and weather conditions. Temperature extremes may be a hazard for consideration depending on the timing of the activity. Refer to Section 5.5 for discussion of recognition of symptoms and controls.

- **Explosion Hazards**

- Gas cylinders: Pressurized gas cylinders will be transported and handled in accordance with applicable Department of Transportation and ORNL guidance and regulations. Care will be taken to secure the cylinders upright during transport to ensure they are not damaged. Cylinders will also be secured at the site so they will not tip over during the injection process. Rules and practices for handling compressed gas cylinders can be found at http://www-internal1.ornl.gov/oshp/nec_suff/gasinfo.htm.

- **Biological/Vector Hazards**

- Ticks/Snakes/Pathogens: Be cautious of snakes, and vector carriers such as ticks. Check clothing and skin for ticks after walking in brush. Wash hands before eating and drinking.

- **Personal Protective Equipment Required to Address General Site Hazards**

- Level of Protection: D
- Protective Clothing: DOE-issued work clothes or disposable tyvek

- Head Gear: Safety glasses
- Gloves: Latex or nitrile (when conducting groundwater sampling or handling corrosive or oxidizing reagents)
- Footwear: Sturdy work shoes
- **Monitoring Requirements**
 - Radiological Monitoring: Although no radiological exposure is expected, the need for radiological monitoring will be reviewed by the Radiological Technicians prior to the start of work.

4.2. TRACER TESTS OR MICROBIAL MANIPULATION AND TRANSPORT STUDIES

Task Description: A description of tracer testing procedures is provided in the NABIR FRC Site Characterization Plan. Microbial manipulative tests may involve injection of nutrients (carbon sources, nitrogen, phosphorous, methane, hydrogen, etc.) into wells for biostimulation or the addition of chemical stimulants for immobilization of contaminants. Bacterial transport research may involve enrichments of indigenous, naturally occurring organisms or the addition of non-indigenous naturally occurring organisms in groundwater. The tracer or microbial stimulant may be injected/pumped directly into the injection well, or in some instances an injection system will consist of a double straddle packer design that will be used to isolate the screened interval in the injection well. A computational datalogger may be used to automatically deliver small increments of a concentrated tracer stock solution through a solenoid valve in order to maintain a constant diluted injection concentration within the packed interval. The fluid in the injection interval will be continuously mixed by re-circulating groundwater through a peristaltic pump and flow-through temperature-compensated conductivity cell. Copper refrigeration tubing may be used for the entire circulation system except for a 15-cm long piece of silicon tubing needed in the pump head. Copper tubing will eliminate the loss of dissolved gas tracers (e.g., He, Ne, SF₆, Kr) that may be co-injected into the same wells. The gas injection and sampling system utilizes molecular diffusion through gas-permeable tubing. Gas is continuously pumped through a coil of Teflon tubing installed in the screened section of the well. The gas diffuses quickly into the surrounding groundwater, coming to a steady-state concentration based on the in situ temperature and pressure conditions, the solubility constant, and the average groundwater flux through the well screen.

Gas samples will be obtained from monitoring wells using passive-diffusive samplers consisting of two parts—a length of gas-permeable silicon tubing, and a copper sample tube that is sealed on one end and valved on the other. Dissolved gas diffuses through the silicon tubing and comes to equilibrium with the surrounding groundwater. A portion of the gas is trapped in the copper tube, which is open to the silicon tubing by way of a valve while the sampler is suspended in the well. When the sampler is removed from the well, the silicon tubing is immediately disconnected, closing the valve and sealing in the gas sample. Alternatively, water samples may be obtained using methods similar to those used for sampling some VOCs. In that case, headspace samples would be analyzed for the gas tracers. Anionic tracer and microbial samples are generally collected as described in Sect. 4.1 for groundwater field sampling, although special procedures may be required to maintain anoxic sterile conditions for the microbial samples.

Equipment and Materials: Equipment includes sampling tube (remains in the monitoring wells); peristaltic pump; a YSI multi-probe flow cell (for measuring water field parameters); filters and sample containers (for collecting samples). Non-toxic tracers that may be used include: bromide, fluorescent dyes; ice-nucleating bacteria (INA), PFBA, PIPES, He, Ne, SF₆, Kr and other noble gases. Gas cylinders will be used to transport and store gases. Nutrients may include carbon sources (e.g., lactate), nitrogen, phosphorous, methane, and hydrogen.

Task Hazards and Controls:

- **Chemical and Radiological Hazards**

- **Groundwater Contact:** Based on previously obtained sample data, the risk of chemical or radiological exposure from short-term exposure to groundwater and surface water samples is minimal (Tables A-1, A-2, and A-3 give the results of chemical and radiological contaminant analyses in soils, groundwater, and surface water at representative locations within the FRC contaminated areas). However, direct contact with contaminated materials should be avoided, therefore, disposable latex or nitrile gloves and safety glasses will be worn when conducting groundwater sampling to prevent eye and skin contact.
- **Reagent Contact:** Corrosive or oxidizing reagents pose a contact hazard. To prevent eye and skin contact when corrosive or oxidizing reagents are used disposable latex or nitrile gloves and safety glasses will be worn.

- **Physical Hazards**

- **Compressed gas cylinders:** Rules and practices for handling compressed gas cylinders can be found at http://www-internal1.ornl.gov/oshp/nec_suff/gasinfo.htm.
- **Tripping/Falling:** Precautions should be taken to avoid trip, slip, and fall accidents when climbing irregular or slippery surfaces. Before changing location, visually survey the area for slippery surfaces and tripping hazards.
- **Heat/Cold Stress:** Wear clothing appropriate for environmental and weather conditions. Temperature extremes may be a hazard for consideration depending on the timing of the activity. Refer to Sect. 5.5 for discussion of recognition of symptoms and controls.
- **Lifting:** Use your legs to lift heavy objects; avoid awkward positions and twisting of the body and ask for assistance with awkward or heavy loads.

- **Explosion Hazards**

- **Gas cylinders:** Pressurized gas cylinders will be transported and handled in accordance with applicable DOT and ORNL guidance and regulations. Care will be taken to secure the cylinders upright during transport to ensure they are not damaged. Cylinders will also be secured at the site so they will not tip over during the injection process. Rules and practices for handling gas cylinders can be found at http://www-internal1.ornl.gov/oshp/nec_suff/gasinfo.htm.

- **Biological/Vector Hazards**

- Ticks/Snakes/Pathogens: Be cautious of snakes, and vector carriers such as ticks. Check clothing and skin for ticks after walking in brush. Wash hands before eating and drinking.

- **Personal Protective Equipment Required to Address General Site Hazards**

- Level of Protection: D
- Protective Clothing: DOE-issued work clothes or disposable tyvek
- Head Gear: Safety glasses
- Gloves: Latex or nitrile (when conducting groundwater sampling or handling corrosive or oxidizing reagents)
- Footwear: Sturdy work shoes

- **Monitoring Requirements**

- Radiological Monitoring: Although no radiological exposure is expected, the need for radiological monitoring will be reviewed by the Radiological Technicians prior to the start of work.

4.3. WATER LEVEL MEASUREMENTS

Task Description: Manual water levels are taken by lowering an electronic water level sounder down the well. As the sounder is brought out of the well the tip of the sounder that has been submerged is rinsed with distilled water to rinse off the groundwater. The rinse water is allowed to drip back down into the well. Sampling tubes at some locations have to be removed prior to taking a water level measurement. The top of the well casing will be surveyed for location and elevation.

Water level measurements taken with data loggers and transducers will be downloaded with a portable computer via a cable that runs out of the well. Contact with subsurface contaminants is not likely to occur when downloading data. Transducers will be rinsed when moved from well to well.

Equipment and Materials: Equipment includes water level sounder, transducers, data loggers, computers, and survey equipment

Task Hazards and Controls:

- **Chemical and Radiological Hazards**

- Groundwater Contact: Based on previously obtained sample data, the risk of chemical or radiological exposure from short-term exposure to groundwater and surface water samples is minimal (Tables A-1, A-2, and A-3 give the results of chemical and radiological contaminant analyses in soils, groundwater, and surface water at representative locations within the FRC contaminated areas). However, direct contact with contaminated materials should be avoided;

therefore, disposable latex or nitrile gloves and safety glasses will be worn when conducting groundwater monitoring and during the handling of sample tubes and downhole transducers to prevent eye and skin contact.

- Downhole equipment: Rinse downhole equipment with distilled water as it is brought out of the well. Scanning of downhole equipment for possible radiological contamination will be required if the equipment is to be moved offsite but not when moving equipment between wells.

- **Physical Hazards**

- Tripping/Falling: Precautions should be taken to avoid trip, slip, and fall accidents when climbing irregular or slippery surfaces. Before changing location visually survey the area for slippery surfaces and tripping hazards.
- Heat/Cold Stress: Wear clothing appropriate for environmental and weather conditions. Temperature extremes may be a hazard for consideration depending on the timing of the activity. Refer to Section 5.5 for discussion of recognition of symptoms and controls.

- **Biological/Vector Hazards**

- Ticks/Snakes/Pathogens: Be cautious of snakes, and vector carriers such as ticks. Check clothing and skin for ticks after walking in brush. Wash hands before eating and drinking.

- **Personal Protective Equipment Required to Address General Site Hazards**

- Level of Protection: D
- Protective Clothing: DOE-issued work clothes or disposable tyvek
- Head Gear: Safety glasses
- Gloves: Latex or nitrile (when conducting groundwater sampling or handling corrosive or oxidizing reagents)
- Footwear: Sturdy work shoes

- **Monitoring Requirements**

- Radiological Monitoring: Although no radiological exposure is expected, the need for radiological monitoring will be reviewed by the Radiological Technicians prior to the start of work

4.4. HYDRAULIC TESTING (E.G., PUMPING TESTS, SLUG TESTS, POINT DILUTION TESTS AND FLOW METERS SUCH AS THE COLLOIDAL BORESCOPE)

Task Description: Pumping tests are conducted by pumping groundwater from a well at a constant rate of discharge. Water levels in the pumped well and nearby well are monitored with a water level

sounder or data logger and transducer. The groundwater will be discharged to storage containers like 55-gallon drums or in some cases to the ground if regulatory approval is obtained.

Slug tests are conducted by placing a solid slug into a well and displacing a known amount of water. The slug is quickly removed and water levels are taken (with a transducer and data logger or manually with a water level sounder) to monitor groundwater recovery in the well.

Point dilution tests in uncased wells will be conducted by using a dual packer apparatus to isolate a small section of the well. For drivepoint wells targeting designated depths within the formation, the method will utilize a single packer apparatus to isolate the screened interval since the bottom of the well is already sealed. Groundwater in the test interval will be slowly replaced with deionized water and the specific conductance and pressure-head monitored continuously.

Flow meter (e.g., colloidal borescope or electromagnetic borehole flowmeter) measurements are taken by lowering the flowmeter into a well and using above-ground equipment (i.e., computers) to monitor the rate and direction of flow. The equipment is rinsed off with distilled water as it is removed from the well.

Equipment and Materials: Equipment includes peristaltic pumps, well packers and compressor to inflate the packers, water level sounder, transducers, data loggers and computers.

Task Hazards and Controls:

- **Chemical and Radiological Hazards**

- **Groundwater Contact:** Based on previously obtained sample data, the risk of chemical or radiological exposure from short-term exposure to groundwater and surface water samples is minimal (Tables A-1, A-2, and A-3 give the results of chemical and radiological contaminant analyses in soils, groundwater, and surface water at representative locations within the FRC contaminated areas). However, direct contact with contaminated materials should be avoided; therefore, disposable latex or nitrile gloves and safety glasses will be worn when conducting groundwater sampling to prevent eye and skin contact.

- **Physical Hazards**

- **Tripping/Falling:** Precautions should be taken to avoid trip, slip, and fall accidents when climbing irregular or slippery surfaces. Before changing location visually survey the area for slippery surfaces and tripping hazards.
- **Heat/Cold Stress:** Wear clothing appropriate for environmental and weather conditions. Temperature extremes may be a hazard for consideration depending on the timing of the activity. Refer to Sect. 5.5 for recognition of symptoms and controls.
- **Lifting:** Use your legs to lift heavy objects, avoid awkward positions and twisting of the body and ask for assistance with awkward or heavy loads.

- **Biological/Vector Hazards**

- Ticks/Snakes/Pathogens: Be cautious of snakes, and vector carriers such as ticks. Check clothing and skin for ticks after walking in brush. Wash hands before eating and drinking.

- **Personal Protective Equipment Required to Address General Site Hazards**

- Level of Protection: D
- Protective Clothing: DOE-issued work clothes or disposable tyvek
- Head Gear: Safety glasses
- Gloves: Latex or nitrile (when conducting groundwater sampling or handling corrosive or oxidizing reagents)
- Footwear: Sturdy work shoes

- **Monitoring Requirements**

Radiological Monitoring: Although no radiological exposure is expected, the need for radiological monitoring will be reviewed by the Radiological Technicians prior to the start of work

4.5. CORING AND WELL INSTALLATION

Task Description: Pushprobes are installed by using a drill rig either hydraulically pushing or hammering steel drive pipe into the ground (please refer to the FRC Site Characterization Plan for a more complete description of coring and well installation). Sections of piping are added (threaded attachment) until the desired depth is reached. A small diameter well can then be constructed inside the hollow pipe as it is withdrawn from the ground or in the uncased hole after the drive pipe is removed completely. The drive point is either left in the ground or withdrawn through the hollow drive pipe. Soil cores can be taken during drilling operations by driving split-spoon or other types of samplers. The core samples will be scanned and processed at the surface. Special procedures and use of compressed inert gas such as nitrogen or argon may be required to maintain anoxic sterile conditions for some core samples that will have microbial analyses conducted on them. Sampling equipment and drive pipe is cleaned and decontaminated by pressure washing. Hollow-stem augers and other drilling methods may also be used to install groundwater monitoring wells. These methods produce drill cuttings that need to be contained and managed according to procedures outlined in the FRC Management Plan and site specific research plan prepared for the project.

Equipment and Materials: Equipment includes drill rigs and associated equipment and support vehicles such as air compressors, pressure washers, generators, drill rod, containment boxes equipped with HEPA filters, and well construction materials. A glove bag and compressed gas cylinders may be used to process cores that require microbial analyses.

Task Hazards and Controls:

- **Chemical and Radiological Hazards**

- **Groundwater Contact:** Based on previously obtained sample data, the risk of chemical or radiological exposure from short-term exposure to groundwater and surface water samples is minimal (Tables A-1, A-2, and A-3 give the results of chemical and radiological contaminant analyses in soils, groundwater, and surface water at representative locations within the FRC contaminated areas). However, direct contact with contaminated materials should be avoided, therefore, disposable latex or nitrile gloves and safety glasses will be worn when conducting groundwater sampling to prevent eye and skin contact.
- **Soil/cuttings Contact:** Workers could be exposed to contaminated soil remaining on the piping as it is raised out of the ground. This hazard will be minimized by scanning the drive pipe as it is raised out of the hole. Prior to removal from the site, all drill pipe, drill cuttings, and any core samples collected will be scanned for radionuclide contamination. An exclusion area will be set up around the drill rig to prevent entry by personnel that are not trained or wearing proper protection. A minimum of two people are required for this operation. An RWP will be required if drilling is to be performed in areas contaminated with radionuclides, and containment boxes equipped with HEPA filters will be used as specified by the RWP.

- **Physical Hazards**

- **Compressed gas cylinders:** Rules and practices for handling compressed gas cylinders can be found at http://www-international.ornl.gov/oshp/nec_suff/gasinfo.htm.
- **Tripping/Falling:** Precautions should be taken to avoid trip, slip, and fall accidents when climbing irregular or slippery surfaces. Before changing location visually survey the area for slippery surfaces and tripping hazards.
- **Heat/Cold Stress:** Wear clothing appropriate for environmental and weather conditions. Temperature extremes may be a hazard for consideration depending on the timing of the activity. Refer to Sect. 5.5 for discussion of recognition of symptoms and controls.
- **Abrasions, Scrapes and Sprains:** Always use appropriate care when using tools and mechanical equipment. Maintain awareness of body and limb location and think ahead to probable body and object path before applying force to tools. Wear protective clothing as listed below.
- **Lifting:** Use your legs to lift heavy objects, avoid awkward positions and twisting of the body and ask for assistance with awkward or heavy loads.
- **Mechanical Hazard:** Working with drill rigs can result in injuries from equipment dislodging and striking unsuspecting personnel, and from impacts due to flying objects or overturning vehicles. Therefore, follow these precautions:
 - Drill rig brakes, hydraulic lines, light signals, fire extinguishers, fluid levels, steering, tires, horns, and other safety devices will be inspected routinely throughout the project.
 - Drill rig cabs will be kept free of all nonessential items and all loose items will be secured.
 - Drill rigs will be provided with necessary safety equipment, including seat belts.

- Parking brakes will be set before shutting off any heavy equipment or vehicle.
- Electrical Hazard: Of special concern to drilling operations is the possibility for conducting electricity through the drilling tower through either inadvertent contact with underground or overhead power lines, or by lightning strikes. In addition, some of the equipment used is operated by electricity. Unless safe work practices are observed, serious injury or death can result. Therefore, observe the following precautions:
 - Treat all electrical wires and circuits as ‘live’ unless certain they are not.
 - Always maintain a firm work base to prevent a loss of balance and potential fall onto energized busses or parts (which should be covered with a good electrical insulator such as a rubber blanket).
 - All tools should have insulated handles, be electrically grounded, or double insulated.
 - Do not drill within 10 ft of an overhead power line that is ≤ 50 kV (or within 50 ft for > 50 kV) unless power to the line is first turned off for the duration of the drilling.
 - Ground fault circuit interrupters will be used for electrical extension cords in use between a fixed electrical system (permanent outlet) and a tool.
 - Prior to drilling have site representatives delineate location of underground power lines and other utilities (accomplished through penetration permits as part of ISMS process).
 - Do not drill within 25 ft of any known underground power line.
 - Maintain a watch for electrical storms. If electrical activity appears to be imminent, cease drilling operations and evacuate the area around the drill rig. If time permits do not leave auger or drill string in the borehole.
- Noise: Unprotected exposure of site workers to noise from drilling activities can result in noise induced hearing loss. Hearing protection must be worn where noise levels are greater than 85 dBA. The SSHO will ensure that either ear muffs or disposable foam earplugs are made available to all personnel and are used by the personnel in the immediate vicinity of the drill rig.
- **Explosion Hazards**
 - Gas cylinders: Pressurized gas cylinders will be transported and handled in accordance with applicable DOT and ORNL guidance and regulations. Care will be taken to secure the cylinders upright during transport to ensure they are not damaged. Cylinders will also be secured at the site so they will not tip over during the injection process. Rules and practices for handling gas cylinders can be found at http://www-internal1.ornl.gov/oshp/nec_suff/gasinfo.htm.
- **Biological/Vector Hazards**
 - Ticks/Snakes/Pathogens: Be cautious of snakes, and vector carriers such as ticks. Check clothing and skin for ticks after walking in brush. Wash hands before eating and drinking.
- **Personal Protective Equipment Required to Address General Site Hazards**
 - Level of Protection: D
 - Protective Clothing: DOE-issued work clothes or disposable tyvek
 - Head Gear

- Hard hat required for drill rig operations; not required for steam cleaning and washing
- Safety glasses or goggles required during drilling and decon operations
- Ear muffs or disposable foam earplugs required in the vicinity of drill rig
- Gloves: Leather work gloves over nitrile or latex gloves during drilling or decon operations
- Footwear: Steel-toed work shoes
- **Monitoring Requirements -**
 - Radionuclide Contamination: Prior to being removed from the site, all drill pipe, drill cuttings and any core samples collected will be scanned for radionuclide contamination. An exclusion area will be set up around the drill rig to prevent entry of people that are not trained or wearing the proper protection. A minimum of two people is required for this operation. An RWP will be required if drilling in areas contaminated with radionuclides.
 - Radiological Monitoring: Although no radiological exposure is expected, the need for radiological monitoring will be reviewed by the Radiological Technicians prior to the start of work
 - Air Quality: Air monitoring with an organic vapor analyzer or other suitable instrument will be required if in areas where soils or groundwater heavily contaminated with VOCs may be brought to the surface. However, high VOC concentrations are not expected to be encountered at the FRC.

5. OTHER HEALTH AND SAFETY PLAN ELEMENTS

5.1. REVISIONS/ MODIFICATIONS TO THE HASP

The following actions will warrant revision and approval of this plan by the appropriate health and safety disciplines:

- Change in tasks (or previously unidentified tasks) that could impact employee health and safety
- Changes in hazards (unknown or not previously addressed) which require a significant change in, or addition to, respiratory protection (as defined in exemptions to the plan modifications), physical/barrier protection features, or other engineering controls
- Occurrences as defined by DOE Order 232.1A

5.1.1. Modifications allowed

Radiological Conditions. Under the direction of the field health physics technician, the level of personal protective equipment (PPE) may be upgraded including use of air-purifying respirators, for radiological issues. These changes must be documented in the field logbook. The specific change and reason or evidence for the change must be documented in the field logbook. Any upgrades beyond air-purifying respirators will require additional review/approval from the health and safety disciplines and revision of this plan. The RWP shall be continuously updated to reflect the radiological hazards of the work environment.

Non-Radiological Conditions. The SSHO may upgrade PPE for non-radiological issues and contaminants. These changes must be documented in the field logbook. The change and reason or evidence for the change must also be documented in the field logbook. For upgrades to include respiratory protection (including air-purifying and supplied air) for previously unidentified non-radiological issues or contaminants such as VOCs, the appropriate health and safety disciplines must be contacted. The SSHO will approve and document changes in PPE in the field logbook. Upgrades to include respiratory protection will require the SSHO to ensure workers have 40 Hour HAZWOPER Training and to assess any additional medical surveillance requirements.

5.2. MONITORING

Both historical site data and current well monitoring data indicate that chemical and radiological exposure or radiological contamination of site personnel is not a significant concern within the scope of this project. Therefore, other than for coring and well installation (see Section 4.5) no additional monitoring is required unless there is reason to suspect, based on information identified in the project specific ESH&Q requirements reviews conducted through the ISMS process, that chemical or radiological contamination will be encountered during field activities.

Instruments used by ORNL Industrial Hygiene representatives will be calibrated and maintained in accordance with Industrial Hygiene Standard Operating Procedures. Instruments used by the Office of Radiation Protection are calibrated and source checked in accordance with established Health Physics procedures. Site monitoring requirements may change based on site conditions. All changes must be documented in the site logbook.

5.3. SITE AND SPILL CONTROL

Site access is available from public roads through the area and therefore will not be controlled to the general site. Based on the anticipated levels of contamination, formal barricaded work zones will not be established unless new monitoring data indicate the need for such barriers. An exclusion zone may be required for drilling operations if required to reduce the accidental spread of hazardous substances from contaminated areas to clean areas. The Health Physics representative will determine the need for radiological postings. The SSHO will determine, as needed, the locations of the support zone, contamination reduction zone, and the exclusion zone. Personnel accessing the zones must meet access requirements as stated in this plan.

Only milliliter quantities of reagents which could pose hazards will be used at a time on this project. Required controls when using such reagents are latex or nitrile gloves and safety glasses. Emergency eye wash shall be present and operational at the site. Best management practices will be employed to minimize and control spillage. MSDSs for many of the reagents are included in Appendix B. MSDSs for additional chemicals can be accessed through the ORNL web server at http://hmweb.ctd.ornl.gov/msds/msds_home.htm. In the event of eye contact with corrosive or oxidizing reagents, an emergency eye wash shall be used. For eye or skin contact immediately flush affected areas with water for 15 minutes.

5.4. PERSONAL PROTECTIVE EQUIPMENT

Level D protection is normally used when the potential for personnel contamination is low, as is the case with this project. Level D protection will include DOE-furnished clothing or disposable tyvek. Details and special requirements have been covered in the hazard control sections of the specific tasks in Sect. 4 above. Unexpected new hazards will require a reassessment of the specified PPE.

5.5. TEMPERATURE EXTREMES AND SITE CHARACTERISTICS

The effect of temperature extremes on personnel is a primary hazard associated with the activities conducted at the FRC. Symptoms and controls related to temperature extremes are considered in detail in this section.

Field activities conducted during the summer or winter pose a hazard because of temperature extremes. Since the project site is located in a relatively open area, workers shall dress appropriately for environmental conditions, wearing clothing that provides reasonable protection against winter cold and summer sun. Although extreme physical exertion will not be likely within the scope of this project, during hot weather workers are encouraged to be aware of their own symptoms of heat stress (headaches, dizziness, increased heart rate), to drink plenty of water, and to take breaks as needed. Heat stress symptoms, remedies, and monitoring are discussed in Sect. 5.5.1. Cold exposure effects are discussed in Sect. 5.5.2.

Workers are also encouraged to apply insect repellent and/or sunscreen as needed prior to field activities. Workers should exercise caution by visually inspecting their immediate area of activity for presence of poisonous/harmful plant, insect, and animal species as well as any hazard resulting from previous human activity.

5.5.1. Effects and Prevention of Heat Stress

If the body's physiological processes fail to maintain a normal body temperature because of excessive heat, a number of physical reactions can occur. They can range from mild symptoms such as fatigue, irritability, anxiety, and decreased concentration, dexterity, or movement, to death.

Heat-related health concerns can include the following:

- **Heat rash:** Caused by continuous exposure to heat and humid air and aggravated by chafing clothes. Decreases ability to tolerate heat and is a nuisance.
- **Heat cramps:** Caused by profuse perspiration combined with inadequate fluid intake and chemical replacement, particularly salts. Signs include muscle spasm and pain in the extremities and abdomen.
- **Heat exhaustion:** Caused by increased stress on various organs to meet increased demands to cool the body. Signs include shortness of breath; increased pulse rate (120-200 beats per minute); pale, cool, moist skin; profuse sweating; dizziness; and lassitude.
- **Heat stroke:** Is the most severe form of heat stress. Body must be cooled immediately to prevent severe injury and/or death. Signs include red, hot, dry skin; no perspiration; nausea; dizziness and confusion; strong, rapid pulse; and possibly coma. Medical help must be obtained immediately.

Medical attention must be obtained for the more serious symptoms of heat stress. One or more of the following methods is recommended to help reduce the potential for heat stress:

1. Provide plenty of liquids. To replace body fluids (water and electrolytes) lost due to sweating, use a 0.1 percent saltwater solution, more heavily salted foods, or commercial mixes. The commercial mixes may be preferable for those employees on a low-sodium diet.
2. Provide cooling devices to aid natural body ventilation. These devices, however, add weight, and their use should be balanced against worker efficiency.
3. Wear long cotton underwear, which acts as a wick to help absorb moisture and protect the skin from direct contact with heat-absorbing protective clothing.
4. Install mobile showers and/or hose-down facilities to reduce body temperature and cool protective clothing.
5. In extremely hot weather, conduct non-emergency response operations in the early morning or evening.
6. Ensure that adequate shelter is available to protect personnel against sun, heat, or other adverse weather conditions that decrease physical efficiency and increase the probability of accidents.
7. In hot weather, rotate workers wearing protective clothing.
8. Maintain good hygiene frequently changing clothing and showering daily. Clothing should be permitted to dry during rest periods. Workers who notice skin problems should immediately consult medical personnel.

5.5.2. Cold Exposure

Persons working outdoors in temperatures at or below freezing may suffer from cold exposure. During prolonged outdoor periods with inadequate clothing for protection, the effects of cold exposure may occur even at temperatures well above freezing. Cold exposure may cause severe injury due to freezing of exposed body surfaces (frostbite), or profound generalized cooling (hypothermia), possibly resulting in death. Areas of the body which have high surface area-to-volume ratios such as fingers, toes, and ears are the most susceptible to frostbite.

Local injury resulting from cold is included in the generic term frostbite. There are several degrees of damage. Frostbite of the extremities can be categorized into:

- **Frost nip or incident frostbite:** characterized by sudden blanching or whitening of skin.
- **Superficial frostbite:** skin has a waxy or white appearance and is firm to the touch, but tissue beneath is resilient.
- **Deep frostbite:** tissues are cold, pale, and solid; extremely serious injury.

Systemic hypothermia, or lowering of the core body temperature, is caused by exposure to freezing or rapidly dropping temperatures. Symptoms are usually exhibited in five stages: 1) shivering and loss of coordination; 2) apathy, listlessness, sleepiness, and (sometimes) rapid cooling of the body to less than 95°F (35°C); 3) unconsciousness, glassy stare, slow pulse, and slow respiratory rate; 4) freezing the extremities; and 5) death.

5.6. DECONTAMINATION

Decontamination of personnel shall be conducted only in the unexpected event that contamination is detected. Decontamination efforts shall be carried out in accordance with Radiological Surveillance Section Standard Operating Procedure 02-540-01, *Handling Radiologically Contaminated Personnel*. At a minimum, personnel who have conducted work at the site will wash their hands prior to eating or drinking. Health Physics personnel shall supervise, assist, and document incidents involving personnel contamination.

If contamination is detected on the drilling equipment, ESD decontamination equipment is available for use such as a steam cleaner, pressure washer, water reservoir tank, and a wastewater transfer system and receiving tank.

Radiological decontamination efforts shall be conducted with the guidance of Health Physics personnel. A Radiation Protection Specialist may be reached at telephone (865) 576-1408.

5.7. EMERGENCY PREPAREDNESS/RESPONSE

Personnel will not be in residence at the FRC and therefore, a formal emergency response plan is not appropriate. The site is in close proximity to several occupied buildings at the Y-12 Plant. In the event of an area evacuation, personnel will muster at Y-12 Assembly Point 21. The Y-12 Plant emergency response organization will be contacted for response to all emergencies at the project site. Emergency medical treatment and first aid is immediately available at the Y-12 Plant. All emergency services can be reached by dialing 911 from any plant telephone. Access to phones and/or radios will be provided to onsite personnel. The Plant Shift Supervisor will coordinate all emergency response operations.

Should evacuation from the site become necessary, the evacuation route to the hospital in the City of Oak Ridge is shown in Fig. 1.1. Emergency telephone numbers are given below. For a complete listing of individuals and organizations important to operation of the FRC, refer to the FRC Management Plan.

Emergency Telephone Numbers

Y-12 Plant Shift Supervisor	(865) 574-7172 or 911 from any plant telephone
Y-12 Medical Services	(865) 574-1583 (Building 9706-2) or 911 from any plant telephone
ORNL Laboratory Shift Superintendent	(865) 574-6606
ORNL Medical Services	(865) 574-7537 (Building 4500N, Rm K-125)
FRC Manager	(865) 241-4749
Radiation Protection Specialist	(865) 576-1408 (865) 873-4829 pager
ESH&Q Assurance Specialist	(865) 574-7837

6. TRAINING/MEDICAL REQUIREMENTS

6.1. SITE-SPECIFIC HAZARD COMMUNICATION AND ACCESS BRIEFING

Since different training requirements may be needed based on the nature of different tasks to be performed, specific training requirements (e.g., RAD Worker II, Respirator) will be identified in the project specific ESH&Q requirements lists. However, generally applicable training requirements are presented here.

Visitors not entering any exclusion zone or contamination reduction zone who have very limited potential for exposure to contaminants require:

- Site-specific hazard communication and access briefing

All project personnel performing hands-on work that could potentially expose them to hazardous substances, safety, or health hazards will meet the following training requirements:

- General Employee Training and General Employee Radiological Training (GET/GERT)
- 40 hour HAZWOPER (SARA/OSHA) training, or equivalent (Note: for certain types of low risk work, 24 hour training is acceptable)
- Current HAZWOPER 8-hour Annual Refresher (as applicable)
- Site-specific hazard communication and access briefing

In addition, the Site Safety and Health Officer requires:

- 8-hour HAZWOPER Supervisor training

Personnel involved in service or maintenance work on energized equipment require:

- Lockout/Tagout training

Prior to beginning work at the project site, all personnel will review this Health and Safety Plan and sign the training acknowledgment form (Appendix C). The site-specific hazard communication and access briefing is documented in the project logbook. If site conditions change, or other hazards are detected, the training and access requirements will be revised accordingly. For example, if radiological contamination is detected, only those who have satisfactorily completed Radiological Worker Training II may perform hands-on work in the contaminated area.

6.2. MEDICAL SURVEILLANCE

A medical surveillance program will be conducted in accordance with the requirements of 29 CFR 1910.120 for:

- All employees who are or may be exposed to hazardous substances or health hazards at or above the established permissible exposure limits or, if there is no permissible exposure limit, above the published exposure levels for these substances, without regard to the use of respirators, for 30 days or more a year
- All employees who wear a respirator for 30 days or more a year or as required by 29 CFR 1910.134
- All employees who are injured, become ill or develop signs or symptoms due to possible overexposure involving hazardous substances or health hazards from an emergency response or hazardous waste operation
- Members of HAZMAT teams

All ORNL employees receive periodic medical examinations. Because of the low potential for exposure to hazardous agents, it is not expected that additional medical surveillance will be required for ORNL personnel at the FRC. Non-ORNL personnel will be required to acknowledge coverage by a medical surveillance program sufficient to satisfy the requirements of 29 CFR 1910.120 (Appendix C).

Appendix A
DATA TABLES

Table A-1. Results of chemical analysis of wastes, soils, groundwater, and surface water at the S-3 Ponds Site FA

Analyte ^d	Wastes	Soils ^a				Groundwater ^b				Surface Water ^c			
	S-3 sludges	Results > detection limit	Maximum detect	Average result	SRC ?	Freq. of wells w. detects	Max detect	Mean of the medians ^e	SRC ?	Freq. of detect	Avg. ^f result BCK 12.4 6	Avg. ^f result NT-1	SRC ?
Inorganics (water - mg/L, soils - mg/kg)													
Aluminum	22134	40/ 40	29000	15600		23/ 23	800	81.05	Y	70/ 82	0.506	0.56	
Antimony		2/ 2	0.34	0.3		0/ 20	.	0.025					
Arsenic	1.12	40/ 40	20.5	3.5		1/ 9	0.009	0.003					
Barium	133.5	40/ 40	712	145	Y	24/ 24	380	19.137	Y	77/ 78	0.092	0.554	Y
Beryllium	2.74	36/ 40	1.8	1.0		11/ 22	0.11	0.0119	Y	3/ 78	0.0000	0.0002	
Boron	27.64	NA				24/ 24	4.40	0.29	Y	78/ 78	0.086	0.073	Y
Cadmium	4.9	2/ 40	2	0.2		10/ 25	4	0.174	Y	3/ 4		0.015	Y
Calcium	42215.6	39/ 39	318000	26700		26/ 26	10,000	1,665.6		78/ 78	164.5	228.3	
Chromium	133.2	40/ 40	69.6	30.8		13/ 25	0.31	0.017	Y				
Cobalt	3.47	40/ 40	31.1	16.6		11/ 23	2.3	0.268	Y	5/ 78	0.001	0.007	
Copper	92.45	38/ 40	50.8	22.3	Y	20/ 21	3.1	0.278	Y	4/ 78	0.005	0.002	
Cyanide	5.95	4/ 40	7.8	0.6	Y	0/	.	.		6/ 72	0.001		Y
Iron	3647	40/ 40	48300	25600		23/ 23	28	3.59		46/ 78	0.743	0.233	
Lead	35.79	40/ 40	82.3	15.5	Y	21/ 26	0.66	0.0106	Y	1/ 4		0.003	
Lithium	75.68					7/ 7	3.5	0.88	Y	33/ 72	0.015		
Magnesium	1941.32	40/ 40	60400	6930		26/ 26	2,500	263.3		78/ 78	23.4	29.8	
Manganese	99.67	40/ 40	2000	707		24/ 24	220	24.162	Y	78/ 78	0.046	3.0	
Mercury	2.28	26/ 39	82.9	7.8	Y	15/ 26	0.1100	0.0042	Y	18/ 72	0.0000		
Molybdenum	15.2	1/ 40	3.7	0.5		3/ 19	0.023	0.006					
Nickel	550.32	40/ 40	128	29.6	Y	22/ 24	20	2.07	Y	5/ 78	0.005	0.068	Y
Niobium	20.87					4/ 5	0.10	0.027	Y				
Phosphorous	952.9									41/ 72	0.058		Y
Potassium	1625.6	40/ 40	3990	2120		26/ 26	200	30.95		78/ 78	5.126	4.5	
Selenium	0.77	2/ 40	0.66	0.31		3/ 10	0.014	0.003		1/ 72	0.001		

Analyte ^d	Wastes	Soils ^a				Groundwater ^b				Surface Water ^c			
	S-3 sludges	Results > detection limit	Maximum detect	Average result	SRC ?	Freq. of wells w. detects	Max detect	Mean of the medians ^e	SRC ?	Freq. of detect	Avg. ^f result BCK 12.4 6	Avg. ^f result NT-1	SRC ?
Silicon						24/ 24	39	9.99					
Silver	1.87	26/ 40	4.3	1.8		0/ 6	.	.					
Sodium	2722.2	32/ 40	313	117		26/ 26	3,200	357.6		78/ 78	57.04	29.5	
Strontium	35.49					22/ 22	340	17.93	Y	78/ 78	0.42	0.692	Y
Thallium	0.33	2/ 40	0.75	0.22		1/ 8	0.01	0.005		2/ 72	0.001		
Thorium	195.1					1/ 20	0.28	0.109		2/ 72	0.006		
Tin	1.57	3/ 40	7.7	1.7		3/ 6	0.018	0.01					
Titanium	398.6					7/ 7	0.85	0.237	Y	3/ 72	0.009		
Total uranium (fluorometric)	991.71					22/ 26	44	2.90	Y	78/ 78	0.621	0.075	Y
Vanadium	7.1	40/ 40	91.9	24.4	Y	5/ 20	0.036	0.004	Y	1/ 72	0.003		
Zinc	58.27	40/ 40	163	50.1	Y	24/ 24	20	0.497	Y	30/ 78	0.013	0.014	
Zirconium	478.4					3/ 4	0.051	0.018		1/ 71	0.002		
Common Anions (water - mg/L, soils - mg/kg)													
Ammonia nitrogen						2/ 4	4.8	1.19					
Chloride						26/ 26	1,341	106.2	Y	6/ 6		27.4	Y
Fluoride						23/ 25	110	1.32	Y	6/ 6		1.0	Y
Kjeldahl nitrogen	460					4/ 4	1.8	0.73					
Nitrate - N	1130					19/ 26	13,400	1,659.	Y	77/ 77	38.83	166.6	Y
Nitrite						1/ 4	6.7	20.2					
Sulfate	220					23/ 23	2,204	204.7	Y	6/ 6		46.8	Y
Organics (water - mg/L, soils - mg/kg)													
Endrin aldehyde		1/ 13	5.4	2.3	Y								
Methoxychlor		1/ 13	5.9	9.8	Y								
PCB-1248	5666.8	4/ 39	3300	108	Y								
PCB-1254		15/ 39	370	59	Y								
PCB-1260		6/ 39	280	38.2	Y								

Analyte ^d	Wastes	Soils ^a				Groundwater ^b				Surface Water ^c			
	S-3 sludges	Results > detection limit	Maximum detect	Average result	SRC ?	Freq. of wells w. detects	Max detect	Mean of the medians ^e	SRC ?	Freq. of detect	Avg. ^f result BCK 12.4 6	Avg. ^f result NT-1	SRC ?
1,1,1-Trichloroethane						9/ 27	28	3.8	Y				
1,1,2-Trichloroethane	75.37					1/ 26	1	2.5					
1,1,2,2-Tetrachloroethane	383.5												
1,1,2-Trichloro-1,2,2-trifluoroethane	4.35												
1,1-Dichloroethene						3/ 26	5	2.5					
1,2-Dichloroethane						1/ 26	4	2.5					
1,2-Dichloroethene						3/ 25	100	5.0	Y				
2-Butoxyethanol	2289.6												
2-(2-Butoxyethoxy)-Ethanol	1908.0												
2,4-Dinitrophenol						1/ 3	77	20.8	Y				
2-Butanone						9/ 26	32	5.0	Y				
2-Chloroethylvinyl ether						1/ 10	4	5					
2-Hexanone		2/ 39	17	6.5	Y	3/ 26	4	5					
2-Hexanol	295.7												
2-Nitrophenol						1/ 3	71	20.3	Y				
3-(1,1-Dimethylethyl)-Phenol	6038.8												
4-Methyl-2-pentanone		5/ 40	28	6.4	Y	1/ 27	97	8.4					
4-Nitrophenol						1/ 3	120	30.3	Y				
Acetone	22.95	17/ 32	4200	275	Y	19/ 27	6,000	51.8	Y	1/ 5		5	Y
Benzene						4/ 26	3	2.5	Y				
Benzenemethanol						1/ 3	2	4.2					
Benzoic acid						2/ 3	58	25.0	Y				
Bis(2-ethylhexyl)phthalate						2/ 3	32	6.3	Y				
Bromodichloromethane						2/ 26	3	2.5					
Bromoform						1/ 26	2	2.5					

Analyte ^a	Wastes	Soils ^a				Groundwater ^b				Surface Water ^c			
		Results > detection limit	Maximum detect	Average result	SRC ?	Freq. of wells w. detects	Max detect	Mean of the medians ^e	SRC ?	Freq. of detect	Avg. ^f result BCK 12.4 ⁶	Avg. ^f result NT-1	SRC ?
Butylbenzylphthalate	S-3 sludges					2/ 3	1	3.3					
Carbon disulfide						5/ 26	2	2.5					
Carbon tetrachloride						1/ 26	0.7	2.5					
Chlorobenzene						2/ 26	3	2.5					
Chloroform						14/ 27	69	7.0	Y				
Chloromethane						1/ 26	10	5					
Dibromochloromethane						1/ 26	1	2.5					
Diethylphthalate	522.8												
Di-n-butylphthalate						1/ 3	2	4.2					
Di-n-octylphthalate						2/ 3	3	3.5					
Dimethylbenzene						5/ 26	16	2.5	Y				
Ethylbenzene						3/ 26	4	2.5					
Methylene chloride	0.49	17/ 32	4200	275	Y	19/ 27	560	17.3	Y				
Naphthalene						1/ 3	1	3.7					
Phenols (mg/L or mg/kg)	7345.8					2/ 7	0.002	0.003	Y	54/ 72	0.0018		Y
Tetrachloroethene	793.0	10/ 40	24	3.9	Y	12/ 27	9,000	269.9	Y	6/ 6		3	Y
Toluene	0.27	19/ 39	120	9.9	Y	11/ 27	35	3.2	Y				
trans-1,2-Dichloroethene						2/ 13	2	2.8					
Trichloroethene	0.28					6/ 27	16	2.9	Y				
Trichlorofluoromethane	0.38												
Vinyl acetate						1/ 26	1	5					
Radioactivity (water - pCi/L, soils pCi/g)													
Alpha activity	925.1	22/ 40	92	10.9		14/ 18	24,400	615.7	Y	75/ 78	270.5	26.3	Y
Americium-241	0.01	3/ 40	0.12	0.01	Y	1/ 4	38	7.5	Y				
Beta activity	1903.2	27/ 40	180	21.6		17/ 18	75,000	2,620.8	Y	78/ 78	164.1	226.7	Y
Cesium-137	4.8					2/ 4	9.7	5.3	Y				

Analyte ^d	Wastes	Soils ^a				Groundwater ^b				Surface Water ^c			
	S-3 sludges	Results > detection limit	Maximum detect	Average result	SRC? ^g	Freq. of wells w. detects	Max detect	Mean of the medians ^e	SRC ?	Freq. of detect	Avg. ^f result BCK 12.4 6	Avg. ^f result NT-1	SRC ?
Neptunium-237	9.9	9/ 40	0.27	0.03		1/ 4	1,090	106.3	Y				
	25.3	2/ 40	0.36	0.02	Y	/ 3	.	.					
	2.5	1/ 38	0.015	0.005		/ 4	.	.					
						1/ 1	35.14	35.14	Y				
	33.3												
	12.9					3/ 4	254	194	Y				
	7520.3	4/ 40	3.6	2.82	Y	3/ 4	80,400	17,538	Y	2/ 2 ^h		206 ^h	Y ^h
	267.3	34/ 40	3.5	0.8		1/ 4	3.2	1.0	Y	1/ 1 ⁱ	0.1030 ⁱ		Y ⁱ
	544.1	35/ 40	3.4	0.7	Y	2/ 4	0.59	0.36	Y				
Thorium-230	87.5	32/ 40	3.6	0.6		/ 3	.	.					
						9/ 12	5406	1245	Y				
	124.1	40/ 40	17	2.1	Y	3/ 4	4,650	660	Y	1/ 1 ⁱ	52.8 ⁱ		Y ⁱ
Uranium-233/234	8.1	22/ 40	0.99	0.12	Y	2/ 4	547	68.8	Y	1/ 1 ⁱ	4.7 ⁱ		Y ⁱ
	332.3	40/ 40	43	4.6	Y	3/ 4	13,600	1,601	Y	1/ 1 ⁱ	127.0 ⁱ		Y ⁱ

^a Soil data are combined results for shallow and deep intervals for both soil aggregates at the S-3 site.

^b Groundwater data are the results for the S-3 site groundwater aggregate.

^c Surface water data are the results for the BCK 12.46 NT-1 aggregate.

^d Analytes detected at least once are summarized. Results reflect data validation and data usability screens.

^e The mean of the medians is the arithmetic mean of the median concentration of an analyte for each well. In calculating the mean of the medians it was assumed that non-detects are equal to one-half the detection limit for chemicals. Radionuclide data qualified as non-detect based on comparison to minimal detectable activities or counting errors are set equal to the reported value.

^f Average result reflects the arithmetic mean of the dataset, assuming non-detects are equal to one-half the detection limit for chemicals. Radionuclide data qualified as non-detect based on comparison to minimal detectable activities or counting errors are set equal to the reported value.

^g ⁹⁹Tc is not an SRC in the Bear Creek BCK 12.46 and NT-1 surface water aggregates; however this analyte is an SRC in the NT-2 surface water aggregate and is only excluded from the NT-1 and BCK 12.46 aggregates because of poor data quality (no MDAs).

^h These radionuclides are not SRCs in the Bear Creek BCK 12.46 and NT-1 surface water aggregates; however they are SRCs in the BCK 12.71 surface water sample and are only excluded from the NT-1 and BCK 12.46 aggregates because of poor data quality (no MDAs).

SRC—site-related contaminant

Table A-2. Results of chemical analysis of groundwater in the Maynardville Limestone and Bear Creek FA and of surface water at SS-4, SS-5, and BCK 9.47

Analyte ^b	Groundwater				SS-4 ^a				SS-5 ^a				Bear Creek at BCK 9.47 ^a			
	Freq. of wells w. detects	Max detect	Mean of the medians ^c	SRC?	Freq. of detect	Max detect	Avg. ^c result	SRC?	Freq. of detect	Max detect	Avg. ^c result	SRC?	Freq. of detect	Max detect	Avg. ^c result	SRC?
Inorganics (mg/L)																
Aluminum	78/ 78	68	0.3		19/ 27	2.98	0.34		17/ 27	0.813	0.098		26/ 35	29.8	1.68	Y
Antimony	1/ 78	0.13	0.027		1/ 13	0.0028	0.001		1/ 13	0.003	0.001		4/ 22	0.003	0.001	
Arsenic	1/ 17	0.005	0.0025										5/ 22	0.023	0.003	
Barium	78/ 78	10	0.23		27/ 27	0.24	0.15		27/ 27	0.12	0.083		33/ 35	0.204	0.099	
Beryllium	40/ 78	0.0039	0.0002						1/ 27	0.0003	0.0002		1/ 35	0.0015	0.0002	
Boron	78/ 78	3	0.16	Y	14/ 14	0.26	0.11	Y	13/ 14	0.18	0.075	Y	13/ 13	4.1	0.80	Y
Cadmium	21/ 82	1.0200	0.008													
Calcium	82/ 82	880	119.52		27/ 27	140	100.2		27/ 27	87	62.73		35/ 35	101	64.67	
Chromium	39/ 82	0.71	0.007										1/ 11	0.01	0.006	
Cobalt	17/ 78	0.140	0.003										3/ 35	0.014	0.002	
Copper	70/ 78	0.19	0.005	Y	4/ 27	0.007	0.002		2/ 27	0.007	0.002		1/ 35	0.005	0.003	
Iron	78/ 78	170	1.82		23/ 27	3.72	0.46		20/ 26	1.13	0.111		34/ 35	38	2.39	
Lead	61/ 82	0.23	0.0046	Y	1/ 12	0.005	0.002		1/ 12	0.012	0.003					
Lithium	5/ 6	0.085	0.029	Y	7/ 7	0.036	0.029		7/ 7	0.014	0.010		7/ 7	0.091	0.060	Y
Magnesium	82/ 82	250	28.58		27/ 27	26	20.27		27/ 27	20	15.34		35/ 35	18.1	11.44	
Manganese	78/ 78	16	0.37	Y	26/ 27	0.809	0.14	Y	21/ 27	0.048	0.007		34/ 35	0.708	0.126	

[illegible]

Analyte ^b	Groundwater			SS-4 ^a				SS-5 ^a				Bear Creek at BCK 9.47 ^a				
	Freq. of wells w. detects	Max detect	Mean of the medians ^c	Freq. of detect	Max detect	Avg. ^c result	SRC?	Freq. of detect	Max detect	Avg. ^c result	SRC?	Freq. of detect	Max detect	Avg. ^c result	SRC?	
Common Anions (mg/L)																
Ammonia nitrogen	1/ 4	2.9	0.1													
Chloride	81/ 82	2,180	49.4	Y	26/ 26	41.5	25.91	Y	26/ 26	23.9	13.5	Y	34/ 34	34.4	17.1	Y
Fluoride	70/ 80	1.9	0.234		26/ 27	0.6	0.362	Y	24/ 27	0.44	0.205		35/ 35	0.4	0.26	Y
Kjeldahl nitrogen	3/ 4	4.9	1.4													
Nitrate	64/ 82	918	29.5	Y	26/ 27	67.6	31.58	Y	26/ 27	27	11.04	Y	35/ 35	46.2	14.47	Y
Nitrite	0/ 4	0	1.625													
Sulfate	82/ 82	2,833	95.9		26/ 27	45	27.7	Y	27/ 27	29	16.75	Y	33/ 35	29.6	21.24	
Organics (µg/L)																
1,1,1-Trichloroethane	25/ 83	43	2.7	Y	2/ 27	1	2.5	Y					1/ 35	0.4	2.5	
1,1-Dichloroethane	16/ 83	21	2.8	Y									3/ 35	2	2.5	Y
1,1-Dichloroethene	18/ 83	36	2.7	Y	3/ 27	3	2.6	Y								
1,2-Dichloroethane	4/ 83	2	2.5										7/ 35	20	5.1	Y
1,2-Dichloroethene	44/ 83	140	5.7	Y	21/ 27	21	7.7	Y	8/ 27	2	2.3	Y	34/ 35	28	7.1	Y
2-Butanone	15/ 83	16	5.1										2/ 35	24	4.2	Y
2-Hexanone	5/ 83	5	5.1													
4-Methyl-2-pentanone	9/ 83	8	5.1						1/ 27	4	3.3		1/ 35	86	5.4	
Acetone	44/ 83	180	5.1	Y					2/ 27	6	3.6	Y	6/ 35	23	6.7	Y

[illegible]

Analyte ^b	Groundwater				SS-4 ^a				SS-5 ^a				Bear Creek at BCK 9.47 ^a			
	Freq. of wells w. detects	Max detect	Mean of the medians ^c	SRC?	Freq. of detect	Max detect	Avg. ^c result	SRC?	Freq. of detect	Max detect	Avg. ^c result	SRC?	Freq. of detect	Max detect	Avg. ^c result	SRC?
Vinyl Chloride	4/ 83	35	5.3													
Radioactivity (pCi/L)																
Alpha activity	43/ 73	108	4.69	Y	27/ 27	130	52.94	Y	22/ 27	75.8	29.35	Y	32/ 32	138	54.64	Y
Beta activity	53/ 73	197	16.7	Y	26/ 26	143	82.29	Y	24/ 26	81.75	37.83	Y	34/ 34	119.8	59.62	Y
Cesium-137	3/ 7	8.8	4.3													
Radium-228	2/ 7	7.8	1.46													
Technetium-99	3/ 8	39	9.38		2/ 3	220	136.6	Y					1/ 7	110	43.86	Y
Thorium-228	2/ 8	0.92	0.24										1/ 3	0.13	0.05	Y
Thorium-230	6/ 8	0.65	0.35		1/ 3	0.11	0.6	Y	1/ 3	0.21	0.14	Y	1/ 3	0.2	0.1	Y
Uranium-234	5/ 8	22	4.06		13/ 13	37.3	27.26	Y	13/ 13	26.6	13.97	Y	21/ 21	29.2	18.74	Y
Uranium-235	1/ 7	0.89	0.16		10/ 13	3.62	1.57	Y	3/ 13	2.98	0.84	Y	6/ 21	1.69	0.9	Y
Uranium-238	4/ 8	42	7.24		13/ 13	82.6	57.59	Y	13/ 13	58.4	26.71	Y	21/ 21	64.5	40.29	Y

^a Groundwater data are the results for the SS-4, SS-5, and BC at BCK 9.47. 114.

^b Analytes detected at least once are summarized. Results reflect data validation and data usability screens.

^c The mean of the medians is the arithmetic mean of the median concentration of an analyte for each well. In calculating the mean of the medians it was assumed that non-detects are equal to one-half the detection limit for chemicals. Radionuclide data qualified as non-detect based on comparison to minimal detectable activities or counting errors are set equal to the reported value.

Table A-3 Groundwater analytical results from the reactive barrier sites

Sample No. (location) Collection date	Pathway 3 (GW-834) 8/20/96				Pathway 2 (GW-835) 8/14/96		Pathway 1 (GW-837) 8/19/96				
	Analysis	Rep 1	Filtered Rep 2	Unfiltered Rep 1	Rep 2	Filtered Rep 1	Unfiltered Rep 1	Rep 1	Filtered Rep 2	Rep 1	Unfiltered Rep 2
Bicarbonate, mg/L			443		426		434				
Mercury, mg/L	0.0002			<0.0002			0.00049	0.00039		0.0012	
Aluminum, ug/L	2760	2670	9860	8210	1220	4550	4690	4630	27900	25500	
Boron, ug/L	102	< 100	114	< 100	108	108	23.1	< 100	39.9	< 100	
Barium, ug/L	>23200	23800	23700	24300	83.5	95.2	483	489	578	587	
Calcium, ug/L	> 1000000	2629000	>1000000	2662000	163000	163000	> 1000000	1647000	>1000000	1681000	
Cadmium, ug/L	411	391	427	404	<20	<20	199	184	204	196	
Cobalt, ug/L	216	212	222	211	<20	<20	257	250	265	265	
Chromium, ug/L	<20	< 100	<20	< 100	<20	<20	<20	< 100	<20	< 100	
Copper, ug/L	65.2	< 200	70.5	<200	<30	<30	58.6	< 200	77.2	< 200	
Iron, ug/L	362	<800	5810	5700	712	4580	207	< 800	14300	14300	
Potassium, ug/L	29000	26500	32000	28200	6380	7300	43200	38800	47900	42400	
Magnesium, ug/L	335000	322000	343000	327000	26000	26400	152000	146000	158000	151000	
Manganese, ug/L	>100000	145000	>100000	147000	1120	1160	100000	157000	> 100000	159000	
Molybdenum, ug/L	<40	<200	<40	< 200	<40	<40	<40	< 200	<40	< 200	
Sodium, ug/L	506000	494000	516000	500000	17400	17300	695000	677000	705000	688000	
Nickel, ug/L	1660	1710	1710	1750	<40	<40	2130	2130	2140	2210	
Lead, ug/L	< 200	< 800	< 200	< 800	<200	< 200	< 200	< 800	< 200	< 800	
Thallium, ug/L	136	< 500	139	< 500	< 100	<100	143	< 500	169	< 500	
Vanadium, ug/L	<10	<50	<10	<50	<10	<10	<10	<50	<10	<50	

Table A-3 (continued)

Sample No. (location) Collection date	Pathway 3 (GW-834) 8/20/96				Pathway 2 (GW-835) 8/14/96		Pathway 1 (GW-837) 8/19/96				
	Analysis	Filtered Rep 1	Filtered Rep 2	Unfiltered Rep 1	Unfiltered Rep 2	Filtered Rep 1	Unfiltered Rep 1	Rep 1	Filtered Rep 2	Rep 1	Unfiltered Rep 2
Zinc, ug/L	33.5	< 100		44.8	< 100	<20	<20	97.6	< 100	119	105
Selenium, ug/L	< 500	< 3000		<500	< 3000	< 500	<500	<500	<3000	< 500	<3000
Silver, ug/L	<20	<80		<20	<80	<20	<20	<20	<80	<20	<80
Arsenic, ug/L	< 100	< 500		< 100	< 500	< 100	< 100	< 100	< 500	< 100	< 500
Beryllium, ug/L	2	< 5.0		2.5	<5.0	< 1.0	< 1.0	2.9	< 5.0	4.5	<5
Antimony, ug/L	< 100	< 500		100	< 500	< 100	<100	< 100	< 500	< 100	< 500
Lithium, ug/L	41.8	<50		50.5	<50	30.6	32.4	119	93.8	143	124
Phosphorous,ug/L	547	<2000		668	< 2000	< 300	< 300	562	< 2000	724	< 2000
Titanium, ug/L	<20	<80		189	96.2	<20	124	<20	<80	244	161
Strontium, ug/L	660	6770		6670	6850	488	490	2390	2440	2450	2500
Alkalinity, mg/L				420			310.1			410	
Alpha activity, pC/L				210			370			790	
Beta activity, pC/L				9000			280			4300	
Tritium, pC/L				1500			46			1100	
Fluoride, mg/L				4.8			0.4			4.9	
Chloride, mg/L				260			28			320	
Nitrite as Nitrogen, mg/L				8.3			0.2			7.3	
Bromide, mg/L				NA			NA			NA	
Nitrate as Nitrogen, mg/L				2300			29			1400	

Table A-3 (continued)

Simple No. (location) Collection date	Pathway 3 (GW-834) 9/20/96		Pathway 2 (GW-835) 8/14/96		Pathway 1 (GW-837) 8/19/96	
	Filleted Rep 1	Rep 2	Unfiltered Rep 1	Rep 2	Filtered Rep 1	Rep 2
Ortho-Phosphate as Phosphorus, mg/L		< 5.0			<0.12	< 5.0
Sulfate, mg/L		14			150	390
22-Sodium Activity, pC/L		1.1			1.5	-1.5
40-Potassium Activity, pC/L		52			50	42
51-Chromium Activity, pC/L		-1.2			8.1	9.7
54-Manganese Activity, pC/L		0.85			1.6	-0.095
57-Cobalt Activity, pC/L		-0.57			0.84	0.3
58-Cobalt Activity, pC/L		-1.2			-1.4	0.49
59-Iron Activity, pC/L		0.9			-0.7	3
60-Cobalt Activity, pC/L		2.3			-1.7	2.9
65-Zinc Activity, pC/L		-0.63			-0.55	1
95-Niobium Activity, pC/L		3.6			-0.5	2.7
95-Zirconium Activity, pC/L		-1.9			-3.3	-1.6
106-Ruthenium Activity, pC/L		-2.2			13	3.9
125-Antimony Activity, pC/L		-0.78			-2.9	2.4

Table A-3 (continued)

Sample No. (location) Collection date	Pathway 3 (GW-834) 9/20/96				Pathway 2 (GW-835) 8/14/96		Pathway 1 (GW-837) 8/19/96			
Analysis	Filleled		Unfiltered		Filtered	Unfiltered	Filtered		Unfiltered	Rep 2
	Rep 1	Rep 2	Rep 1	Rep 2	Rep 1	Rep 1	Rep 1	Rep 2	Rep 1	
134-Cesium Activity, pC/L			-1.2			-0.52			1.2	
137-Cesium Activity, pC/L			-0.77			-0.064			-2.4	
144-Cerium Activity, pC/L			1.3			-3.5			-2.1	
208-Thallium Activity, pC/L			4.5			3.4			3.1	
212-Bismuth Activity, pC/L			13			13			1.8	
212-Lead Activity, pC/L			18			6.4			12	
235 Uranium Activity, pC/L			7.8			5			20	
Technetium-99, pC/L			22000			150			10000	
Total Dissolved Solids, mg/L						690			11000	
Total Strontium, pC/L			-2.4			0.4			360	
Total Suspended Solids, mg/L			190			9				
Uranium, mg/g			0.0037			1.7			2.6	
Unknown, ug/L			65						60	
Acetaldoxime, ug/L			6							
1,2-Ethenediol, Dinitrate, ug/L			16							

Table A-3 (continued)

Sample No. (location) Collection date	Pathway 3 (GW-834) 8/20/96				Pathway 2 (GW-835) 8/14/96		Pathway 1 (GW-837) 8/19/96			
	Filleted		Unfiltered		Filtered	Unfiltered	Filtered		Unfiltered	
Analysis	Rep 1	Rep 2	Rep 1	Rep 2	Rep 1	Rep 1	Rep 1	Rep 2	Rep 1	Rep 2
1,5-Pentanediol, Dinitrate, ug/L			10							
Chloromethane, ug/L			10 U			10 U			3 J	
Bromomethane, ug/L			4 J			10 U			2 J	
Vinyl chloride, ug/L			10 U			10 U			10 U	
Chloroethane, ug/L			10 U			10 U			10 U	
Trichlorofluoromethane, ug/L			10 U			10 U			10 U	
Methylene chloride, ug/L			14			10 U			18	
Acetone, ug/L			12			9 BJ			43	
1,1,2-Trichloro			10 U			5 J			3 J	
1,2,2-trifluoroethane, ug/L										
Carbon disulfide, ug/L			10 U			10 U			10 U	
1,1-Dichloroethene, ug/L			10 U			10 U			10 U	
1, 1 -Dichloroethane, ug/L			10 U			10 U			10 U	
cis-1,2-Dichloroethene, ug/L			6 J			10 U			3 J	
tran-1,2-Dichloroethene, ug/L			10 U			10 U			10 U	
Chloroform, ug/L			9 J			10 U			7 J	
1,2-Dichloroethane, ug/L			10 U			10 U			10 U	
2-Butanone, ug/L			4 BJ			3 BJ			8 BJ	

Table A-3 (continued)

Sample No. (location) Collection date	Pathway 3 (GW-834) 9/20/96		Pathway 2 (GW-835) 8/14/96		Pathway 1 (GW-837) 8/19/96	
Analysis	Unfiltered Rep 1	Rep 2	Rep 1	Rep 2	Rep 1	Rep 2
1,1,1-Trichloroethane, ug/L		10 U	10 U		11	
Carbon tetrachloride, ug/L		10 U		10 U		10 U
Bromodichloromethane, ug/L		10 U		10 U		10 U
1,2-Dichloropropane, ug/L		10 U		10 U		10 U
cis-1,3-Dichloropropene, ug/L		10 U		10 U		10 U
Trichloroethene, ug/L		10 U		10 U		10 U
Dibromochloromethane, ug/L		10 U		10 U		10 U
1,1,2-Trichloroethane, ug/L		10 U		10 U		10 U
Benzene, ug/L		10 U		10 U		10 U
trans-1,3-Dichloropropane, ug/L		10 U		10 U		10 U
Bromoform, ug/L		10 U		10 U		10 U
4-Methyl-2-pentanone, ug/L		10 U		10 U		2 J
2-Hexanone, ug/L		10 U		10 U		10 U
Tetrachloroethene, ug/L		2 J		4 J		14
1,1,2,2-Tetrachloroethane, ug/L		10 U		10 U		10 U

Table A-3 (continued)[illegible]

Appendix B

MATERIAL SAFETY DATA SHEETS

MSDS DATE: 11/06/96
CHANGE NO.: 14574For Assistance, Contact:
Regulatory Affairs Dept.
PO Box 907 Ames, IA 50010
(800) 227-4224MACH COMPANY
PO BOX 907
AMES, IA 50010Emergency Telephone #
Rocky Mountain Poison Ctr.
(303) 623-5716

92178

I. PRODUCT IDENTIFICATION

PRODUCT NAME: Sulfide 1 Reagent
CAS NO.: NA CHEMICAL NAME: Not applicable
FORMULA: Not applicable CHEMICAL FAMILY: Not applicable
MSDS NUMBER: M00213

II. INGREDIENTS

Sulfuric Acid
PCT: 65 CAS NO.: 7664-93-9 SARA: NOT LISTED
TLV: 1 mg/M3 PEL: 1 mg/M3
IARC: LISTED
HAZARD: Causes severe burns. Harmful if inhaled. Known carcinogenOther component
PCT: 1 CAS NO.: NA SARA: NOT LISTED
TLV: Not applicable PEL: Not applicable
HAZARD: Not applicableDemineralized Water
PCT: to 100 CAS NO.: 7732-18-5 SARA: NOT LISTED
TLV: Not applicable PEL: Not applicable
HAZARD: None

Any component of this mixture not specifically listed (eg. "other components") is not considered to present a carcinogen hazard.

III. PHYSICAL DATA

STATE: liquid APPEARANCE: Clear, colorless or light brown ODOR: None
SOLUBILITY IN: WATER: Miscible ACID: Miscible OTHER: Not determined
BOILING POINT: 100°C MELTING PT.: NA SPEC GRAVITY: 1.500 pH: 0.5
VAPOR PRESSURE: Not determined VAPOR DENSITY (air=1): ND
EVAPORATION RATE: High METAL CORROSIVITY - ALUMINUM: Corrosive
STEEL: 0.048 in/yr STABILITY: See Conditions to Avoid
STORAGE PRECAUTIONS: Store in a cool place away from oxidizers and reducers.

IV. FIRE, EXPLOSION HAZARD AND REACTIVITY DATA

FLASH PT.: Not applicable METHOD: NA
FLAMMABILITY LIMITS - LOWER: NA UPPER: NA
SUSCEPTIBILITY TO SPONTANEOUS HEATING: None
SHOCK SENSITIVITY: None AUTOIGNITION PT.: NA
EXTINGUISHING MEDIA: dry chemical. DO NOT USE WATER
FIRE/EXPLOSION HAZARDS: May emit toxic fumes in fire
HAZARDOUS DECOMP. PRODUCTS: May emit toxic fumes of sulfur oxides in fire
OXIDIZER: Mild NFPA Codes: Health 3 Flammability 0 Reactivity 2
NFPA Symbol: 3
CONDITIONS TO AVOID: Heat, flame, contact with oxidizers or reducers,
caustics and caustic fumes, acetic acid, chlorosulfonic acid

V. HEALTH HAZARD DATA

THIS PRODUCT MAY BE: corrosive to eyes, skin and respiratory tract.
ACUTE TOXICITY: Moderately toxic
ROUTES OF EXPOSURE: Ingestion, Inhalation
TARGET ORGANS: Not determined
CHRONIC TOXICITY: Chronic Irritation or Inflammation, Teeth erosion
ROUTES OF EXPOSURE: Inhalation
TARGET ORGANS: Teeth, lungs
CANCER INFORMATION: An ingredient of this mixture is a known carcinogen.
ROUTES OF EXPOSURE: Inhalation
TARGET ORGANS: nasal cavity, paranasal sinus, lungs, larynx
OVEREXPOSURE: Severely burns any tissue contacted. Breathing in the mist or
vapor may cause mouth soreness, teeth erosion and difficulty in breathing.
Inhalation of the mist or vapor of conc. sulfuric acid can cause cancer of
the nasal tissue, lungs and larynx.
MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: Pre-existing eye, skin and
respiratory conditions

VI. PRECAUTIONARY MEASURES

Avoid contact with eyes, skin and clothing
Do not breathe mist or vapor.
Wash thoroughly after handling.
PROTECTIVE EQUIPMENT: adequate ventilation, lab grade goggles, disposable
latex gloves, lab coat

VII. FIRST AID

EYE AND SKIN CONTACT: Immediately flush eyes and skin with water for 15
minutes. Remove contaminated clothing. Call physician.
INGESTION: Do NOT induce vomiting. Give 1 - 2 glasses of water. Call a
physician immediately. Never give anything by mouth to an unconscious
person.
INHALATION: Remove to fresh air. Give artificial respiration if necessary.
Call physician.

VIII. SPILL AND DISPOSAL PROCEDURES

IN CASE OF SPILL OR RELEASE: Cover the spill with excess soda ash or soda
bicarbonate. Scoop slurry to bucket. Adjust pH to between 6 and 9. Flush
to the drain with excess water. Wash site with an alkali solution.
DISPOSE OF IN ACCORDANCE WITH ALL FEDERAL, STATE, AND LOCAL REGULATIONS.

IX. TRANSPORTATION DATA

D.O.T. PROPER SHIPPING NAME: Sulfuric Acid Solution
HAZARD CLASS: 8 ID: UN1830 GROUP: III.C.A.D. PROPER SHIPPING NAME: Sulfuric Acid Solution
HAZARD CLASS: 8 ID: UN1830 GROUP: III.M.O. PROPER SHIPPING NAME: Sulfuric Acid Solution
HAZARD CLASS: 8 ID: UN1830 GROUP: II

X. REFERENCES

- 1) TLV's Threshold Limit Values and Biological Exposure Indices for 1981
1989. American Conference of Governmental Industrial Hygienists, 1981
- 2) Air Contaminants, Federal Register, Vol. 54, No. 12, Thursday, January
19, 1989. pp. 2332-2383.
- 3) In-house information
- 4) Technical judgment
- 5) IARC Monographs on the Evaluation of Carcinogenic Risk to Humans, Vol
Health Organization (Volume 54) 1992, France.

SPECIAL NOTE: The IARC evaluation was based on exposure to the mist or vi
or concentrated sulfuric acid generated during chemical processes.

Post-It Fax Note	Date	4-1	# of pages	3
	From	Steve Clark		
	To	Victor Chang		
	Co/Dept			
	Phone #			
	Fax #			

I. PRODUCT IDENTIFICATION

PRODUCT NAME: Sulfide 2 Reagent
CAS NO.: NA
FORMULA: Not applicable
MSDS NUMBER: M00435
CHEMICAL NAME: Not applicable
CHEMICAL FAMILY: Not applicable

II. INGREDIENTS

Potassium Dichromate
PCT: <1 CAS NO.: 7778-50-9 SARA: LISTED
TLV: 0.05 mg/MJ as Cr PEL: 0.1 mg/MJ (T1V1)
TARC: LISTED HTP: LISTED
HAZARD: Recognized carcinogen; causes severe burns; very toxic

Diluted (Demineralized) Water
PCT: to 100 CAS NO.: 7732-18-5 SARA: NOT LISTED
TLV: Not applicable PEL: Not applicable
HAZARD: None

III. PHYSICAL DATA

STATE: liquid APPEARANCE: Clear, orange ODOR: None
SOLUBILITY IN: WATER: Miscible ACID: Miscible OTHER: Not determined
BOILING POINT: 100°C MELTING PT.: NA SPEC GRAVITY: 0.987 PHI: 4.2
VAPOR PRESSURE: Not determined VAPOR DENSITY (air=1): NA
EVAPORATION RATE: NA METAL CORROSIVITY - ALUMINUM: NA STEEL: NA
STABILITY: Stable
STORAGE PRECAUTIONS: Store tightly closed in a cool, dry place.

IV. FIRE, EXPLOSION HAZARD AND REACTIVITY DATA

FLASH PT.: Not applicable METHOD: NA
FLAMMABILITY LIMITS - LOWER: NA UPPER: NA
SUSCEPTIBILITY TO SPONTANEOUS HEATING: None
SHOCK SENSITIVITY: None AUTOIGNITION PT.: NA
EXTINGUISHING MEDIA: Not applicable
FIRE/EXPLOSION HAZARDS: None
HAZARDOUS DECOMP. PRODUCTS: None
OXIDIZER: No NFPA Codes: Health: 0 Flammability: 0 Reactivity: 0
CONDITIONS TO AVOID: Extreme temperatures, evaporation

V. HEALTH HAZARD DATA

THIS PRODUCT MAY BE: Irritating to eyes and skin, and may cause allergic skin reaction.
ACUTE TOXICITY: Practically non-toxic
ROUTES OF EXPOSURE: Not applicable
TARGET ORGANS: Not applicable
CHRONIC TOXICITY: Not determined
ROUTES OF EXPOSURE: Not determined
TARGET ORGANS: Not determined
CANCER INFORMATION: An ingredient of this mixture is a known carcinogen.
ROUTES OF EXPOSURE: Inhalation
TARGET ORGANS: Lungs, peritoneal sinus, nasal tissue
OVEREXPOSURE: May cause irritation, allergic skin reaction, liver and kidney damage.
MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: Allergies or sensitivity to chromic acid or chromates

VI. PRECAUTIONARY MEASURES

Avoid contact with eyes and skin.
Do not breathe mist or vapor.
Wash thoroughly after handling.
PROTECTIVE EQUIPMENT: adequate ventilation, lab grade goggles, disposable latex gloves

VII. FIRST AID

EYE AND SKIN CONTACT: Immediately flush eyes with water for 15 minutes. Call physician. Remove contaminated clothing. Wash skin with soap and plenty water.
INGESTION: Give large quantities of water or milk. Induce vomiting by sticking finger down throat. Never give anything by mouth to an unconscious person. Call physician.
INHALATION: Not applicable

VIII. SPILL AND DISPOSAL PROCEDURES

IN CASE OF SPILL OR RELEASE: Absorb material on non-reactive material. Set up the material and dispose of in an EPA approved hazardous waste facility. Decontaminate site with a soap solution.
DISPOSE OF IN ACCORDANCE WITH ALL FEDERAL, STATE, AND LOCAL REGULATIONS.

IX. TRANSPORTATION DATA

D.O.T. PROPER SHIPPING NAME: Not Currently Regulated
HAZARD CLASS: NA ID: NA GROUP: NA

I.C.A.O. PROPER SHIPPING NAME: Not Currently Regulated
HAZARD CLASS: NA ID: NA GROUP: NA

I.M.D. PROPER SHIPPING NAME: Not Currently Regulated
HAZARD CLASS: NA ID: NA GROUP: NA

X. REFERENCES

- 1) In-house information
- 2) Technical judgment
- 3) IARC Monographs on the Evaluation of the Carcinogenic Risk of Humans: World Health Organization (Volumes 1-42) Supplement 7, 1987, France.
- 4) Sax, N. Irving. Dangerous Properties of Industrial Materials, 6th Ed New York: Van Nostrand Reinhold Co. 1984.
- 5) NIOSH/OSHA Occupational Health Guidelines for Chemical Hazards. Cincinnati: Department of Health and Human Services, 1981.

SARA: This product contains a chemical or chemicals subject to the report requirements of section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR Part 372.

PER CALIFORNIA PROPOSITION 65: "WARNING - This product contains a chemical known to the State of California to cause cancer."

MSDS DATE: 1/01/95
CHANGE NO.: 12968For Assistance, Contact:
Regulatory Affairs Dept.
PO Box 907 Ames, IA 50010
(800) 227-4224HACH COMPANY
PO BOX 907
AMES, IA 50010Emergency Telephone #
Rocky Mountain Poison Ctr.
(303) 623-5716

I. PRODUCT IDENTIFICATION

PRODUCT NAME: Phenolphthalein Indicator
CAS NO.: NA
FORMULA: Not applicable
MSDS NUMBER: M99088
CHEMICAL NAME: Not applicable
CHEMICAL FAMILY: Not applicable

II. INGREDIENTS

Sodium Chloride
PCT: 995 CAS NO.: 7647-14-5 SARA: Not Listed
TLV: Not established PEL: Not established
HAZARD: May cause eye irritation.Phenolphthalein
PCT: <2 CAS NO.: 77-09-8 SARA: Not Listed
TLV: Not established PEL: Not established
HAZARD: May cause irritationOther component
PCT: <1 CAS NO.: NA SARA: Not Listed
TLV: Not applicable PEL: Not applicable
HAZARD: Not applicable

Any component of this mixture not specifically listed (eg. "other components") is not considered to present a carcinogen hazard.

III. PHYSICAL DATA

STATE: solid APPEARANCE: Pink crystalline powder ODOR: Not determined
SOLUBILITY IN: WATER: Soluble ACID: Not determined
OTHER: Not determined BOILING POINT: NA MELTING PT.: 250 - 262°C
SPEC GRAVITY: 2.10 pH: of 5% soln. = 6.2 VAPOR PRESSURE: Not applicable
VAPOR DENSITY (air=1): NA EVAPORATION RATE: NA
METAL CORROSIVITY - ALUMINUM: NO STEEL: NO STABILITY: Stable
STORAGE PRECAUTIONS: Store in a cool, dry place.

IV. FIRE, EXPLOSION HAZARD AND REACTIVITY DATA

FLASH PT.: Not applicable METHOD: NA
FLAMMABILITY LIMITS - LOWER: NA UPPER: NA
SUSCEPTIBILITY TO SPONTANEOUS HEATING: None
SHOCK SENSITIVITY: None AUTOIGNITION PT.: NO EXTINGUISHING MEDIA: water
FIRE/EXPLOSION HAZARDS: May emit acrid smoke and fumes in fire
HAZARDOUS DECOMP. PRODUCTS: May emit toxic fumes of chloride and sodium
oxide in fire.
OXIDIZER: No NFPA Codes: Health: 1 Flammability: 0 Reactivity: 0
CONDITIONS TO AVOID: Heat, moisture; contact with bromine trifluoride,
lithium

V. HEALTH HAZARD DATA

THIS PRODUCT MAY BE: Irritating to eyes and skin.

ACUTE TOXICITY: Moderately toxic
ROUTES OF EXPOSURE: Ingestion
TARGET ORGANS: Not determined
CHRONIC TOXICITY: Not determined
ROUTES OF EXPOSURE: Not determined
TARGET ORGANS: Not determined
CANCER INFORMATION: Not determined
ROUTES OF EXPOSURE: Not determined
TARGET ORGANS: Not determinedOVEREXPOSURE: Causes moderate eye and mild skin irritation. Produces
dehydration and irritates the stomach if ingested in large quantities,
causing vomiting, diarrhea, muscular twitching and rigidity, collapse,
death. May cause blood pressure problems.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: Pre-existing eye conditions.

VI. PRECAUTIONARY MEASURES

Avoid contact with eyes and skin.
Wash thoroughly after handling.
PROTECTIVE EQUIPMENT: adequate ventilation, lab grade goggles

VII. FIRST AID

EYE AND SKIN CONTACT: Flush with plenty of water.
INGESTION: Give large quantities of water. Call physician immediately
INHALATION: Remove to fresh air.

VIII. SPILL AND DISPOSAL PROCEDURES

IN CASE OF SPILL OR RELEASE: Sweep up powder. Avoid breathing material.
Dissolve in water. Flush down the drain with excess water.
DISPOSE OF IN ACCORDANCE WITH ALL FEDERAL, STATE, AND LOCAL REGULATION

IX. TRANSPORTATION DATA

D.O.T. PROPER SHIPPING NAME: Not Currently Regulated
HAZARD CLASS: NA ID: NA GROUP: NAI.C.A.O. PROPER SHIPPING NAME: Not Currently Regulated
HAZARD CLASS: NA ID: NA GROUP: NAI.M.O. PROPER SHIPPING NAME: Not Currently Regulated
HAZARD CLASS: NA ID: NA GROUP: NA

X. REFERENCES

- 1) TLV's Threshold Limit Values and Biological Exposure Indices for 1989. American Conference of Governmental Industrial Hygienists.
- 2) Air Contaminants, Federal Register, Vol. 54, No. 12, Thursday, Jan 19, 1989, pp. 2332-2763.
- 3) In-house information
- 4) Technical judgment
- 5) Acta Anat. 74: 121-124 (1969)
- 6) Journal of Clinical Investigations 41: 710-714 (1962)

SPECIAL NOTE: In a laboratory test, single subcutaneous injection of
chloride into pregnant mice at the level of 2500 mg/kg caused fetal
and malformations. In a laboratory test, mice given a 2% sodium
solution in place of drinking water during pregnancy produced hydatid
adult offspring.

1037

MATERIAL SAFETY DATA SHEET

MSDS DATE: 10/19/88
CHANGE NO.: 7557For Assistance, Contact:
Regulatory Affairs Dept.
PO Box 367 Ames, IA 50010HACH COMPANY
PO BOX 367
AMES, IA 50010Emergency Telephone 8
Rocky Mountain Poison Ctr.
(503) 623-5716

9098

I. PRODUCT IDENTIFICATION

CATALOG NO.: 1037
CAS NO.: NA
FORMULA: Not applicablePRODUCT NAME: Ferrous Iron Reagent
CHEMICAL NAME: Not applicable
CHEMICAL FAMILY: Not applicable

II. INGREDIENTS

Sodium Bicarbonate

PCT: <100

CAS NO.: 144-55-6

SARA: NOT LISTED

TLV: Not established

PEL: Not established

HAZARD: Moderately toxic and irritating

1,10-Phenanthroline, Monohydrate

PCT: <10

CAS NO.: 5144-67-0

SARA: NOT LISTED

TLV: Not established

PEL: Not established

HAZARD: Very toxic; irritating

III. PHYSICAL DATA

STATE: solid APPEARANCE: White powder ODOR: Not determined
SOLUBILITY IN: WATER: Slightly soluble ACTS: Slightly soluble
OTHER: Not determined BOILING POINT: NA MELTING PT.: 50C decomp.
SPEC GRAVITY: 2.10 pH: Not determined VAPOR PRESSURE: Not applicable
VAPOR DENSITY (air=1): NA EVAPORATION RATE: NA
METAL CORROSIVITY - ALUMINUM: None STEEL: None
STABILITY: See Conditions to Avoid
STORAGE PRECAUTIONS: Store in a cool, dry place.

IV. FIRE, EXPLOSION HAZARD AND REACTIVITY DATA

FLASH PT.: Not applicable METHOD: NA
FLAMMABILITY LIMITS - LOWER: NA UPPER: NA
SUSCEPTIBILITY TO SPONTANEOUS HEATING: None
SHOCK SENSITIVITY: None AUTOIGNITION PT.: ND
EXTINGUISHING MEDIA: water, carbon dioxide, or dry chemical
FIRE/EXPLOSION HAZARDS: May emit toxic fumes and acid smoke in fire
HAZARDOUS DECOMP. PRODUCTS: May emit toxic fumes and acid smoke in fire
OXIDIZER: No NFPA Codes: Health: 1 Flammability: 0 Reactivity: 2
CONDITIONS TO AVOID: Heat, moisture, contact with oxidizers, phosphates

V. HEALTH HAZARD DATA

THIS PRODUCT MAY BE: Irritating to eyes, skin and respiratory tract.

ACUTE TOXICITY: Moderately toxic

ROUTES OF EXPOSURE: Ingestion, inhalation, contact

TARGET ORGANS: Not determined

CHRONIC TOXICITY: Not determined

ROUTES OF EXPOSURE: Not determined

TARGET ORGANS: Not determined

CARCINOGEN, MUTAGEN, TERATOGEN DATA: Not applicable

ROUTES OF EXPOSURE: Not applicable

TARGET ORGANS: Not applicable

OVEREXPOSURE: Irritation

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: None reported

VI. PRECAUTIONARY MEASURES

Wash thoroughly after handling.

Avoid contact with eyes, skin and clothing.

Do not breathe chemicals.

PROTECTIVE EQUIPMENT: adequate ventilation, safety glasses, disposable gloves

VII. FIRST AID

EYE AND SKIN CONTACT: Flush with plenty of water.

INGESTION: Give large quantities of water or milk. Call physician immediately.

INHALATION: Remove to fresh air. Give artificial respiration if not breathing. Call physician.

VIII. SPILL AND DISPOSAL PROCEDURES

IN CASE OF SPILL OR RELEASE: Scoop into a bucket and dissolve in water. Pour down the drain with excess water.

DISPOSE OF IN ACCORDANCE WITH ALL FEDERAL, STATE, AND LOCAL REGULATIONS.

IX. TRANSPORTATION DATA

D.O.T. PROPER SHIPPING NAME: Not Currently Regulated
HAZARD CLASS: Not applicable ID: NAI.C.A.O. PROPER SHIPPING NAME: Not Currently Regulated
HAZARD CLASS: NA ID: NA GROUP: NA

X. REFERENCES

- 1) TLV's Threshold Limit Values and Biological Exposure Indices 1989. American Conference of Governmental Industrial Hygienists
- 2) 29 CFR 1910 - 1910 (Code of Federal Regulations - Labor)
- 3) In-house information
- 4) Technical judgment
- 5) Sax, N. Irving. Dangerous Properties of Industrial Materials New York: Van Nostrand Reinhold Co. 1984.

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.

(C) HACH

Hach Company, WORLD HEADQUARTERS, PO Box 367, Leland, CO 80535

Hach Europe, BP 51, 85300 Nemur 1, BELGIUM

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PGDP HMIS

M. MAKIPIIA RDVS

0002

HACH CO

PGDP HMIS

0002

CAT. NO. 349

MATERIAL SAFETY DATA SHEET

MSDS DATE: 7/22/93
CHANGE NO.: 3745

For Assistance, Contact:
Regulatory Affairs Dept.
PO Box 907 Ames, IA 50010
(505) 227-0224

HACH COMPANY
PO BOX 907
AMES, IA 50010

RECEIVED AUG 02 1993

Emergency Telephone 5
Cedar Mountain Police Dep.
(303) 423-5714

AG394

I. PRODUCT IDENTIFICATION

PRODUCT NAME: Starch Indicator Solution
CAS NO.: NA CHEMICAL NAME: Not applicable
FORMULA: Not applicable CHEMICAL FAMILY: Not applicable

II. INGREDIENTS

Starch, Soluble
PCT: 41 CAS NO.: 9005-86-1 SARAS: NOT LISTED
TLV: Not established PEL: Not established
HAZARD: Dust may cause irritation or allergic reaction

Soluble Acid
PCT: 41 CAS NO.: 67-72-7 SARAS: NOT LISTED
TLV: Not established PEL: Not established
HAZARD: Moderately toxic; severe eye irritant

Deionized Water
PCT: 100 CAS NO.: 7732-18-8 SARAS: NOT LISTED
TLV: Not applicable PEL: Not applicable
HAZARD: None

III. PHYSICAL DATA

STATE: liquid APPEARANCE: White, turbid solution ODOR: None
SOLUBILITY IN: WATER: Miscible ACID: Miscible OTHER: Not determined
BOILING POINT: 100°C MELTING PT.: NA SPEC GRAVITY: 0.996 pH: 3.1
VAPOR PRESSURE: Not determined VAPOR DENSITY (air=1): NA
EVAPORATION RATE: 1.32 METAL CORROSIVITY - ALUMINUM: NA STEEL: NA
STABILITY: Stable
STORAGE PRECAUTIONS: Store tightly closed.

IV. FIRE, EXPLOSION HAZARD AND REACTIVITY DATA

FLASH PT.: Not applicable METHOD: NA
FLAMMABILITY (LFL - LFL): NA UPPER: NA
SUSCEPTIBILITY TO SPONTANEOUS HEATING: None
SHOCK SENSITIVITY: None AUTOIGNITION PT.: NA
EXTINGUISHING MEDIA: Not applicable
FIRE/EXPLOSION HAZARDS: None
HAZARDOUS DECOMP. PRODUCTS: None reported
OXIDIZERS: No MPD Codes: Reactivity: 3 Flammability: 3 Reactivity: 3
CONDITIONS TO AVOID: None

V. HEALTH HAZARD DATA

THIS PRODUCT MAY BE IRRITATING TO EYES.
ACUTE TOXICITY: Practically non-toxic
ROUTES OF EXPOSURE: Not applicable
TARGET ORGANS: Not applicable
CHRONIC TOXICITY: Practically non-toxic
ROUTES OF EXPOSURE: Not applicable
TARGET ORGANS: Not applicable
CANCER INFORMATION: experimental mutagen and experimental teratogen
ROUTES OF EXPOSURE: Not determined
TARGET ORGANS: Not determined
OVEREXPOSURE: May cause eye irritation
MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: Allergies or sensitivity to
cellulose wads.

VI. PRECAUTIONARY MEASURES

Avoid contact with eyes and skin.
Wash thoroughly after handling.
PROTECTIVE EQUIPMENT: lab grade goggles

VII. FIRST AID

EYE AND SKIN CONTACT: Immediately flush eyes with water for 15 minutes.
Wash skin with soap and plenty of water.
INGESTION: Give large quantities of water. Call physician immediately.
INHALATION: Not applicable

VIII. SPILL AND DISPOSAL PROCEDURES

IN CASE OF SPILL OR RELEASE: Dilute with water. Pour down the drain.
DISPOSE OF IN ACCORDANCE WITH ALL FEDERAL, STATE, AND LOCAL REGULATIONS.

IX. TRANSPORTATION DATA

D.O.T. PROPER SHIPPING NAME: Not Currently Regulated
HAZARD CLASS: Not applicable ID: NA

I.C.A.O. PROPER SHIPPING NAME: Not Currently Regulated
HAZARD CLASS: NA ID: NA GROUP: NA

I.M.O. PROPER SHIPPING NAME: Not Currently Regulated
HAZARD CLASS: NA ID: NA GROUP: NA

X. REFERENCES

- 1) TLV's Threshold Limit Values and Biological Exposure Indices 1989, American Conference of Governmental Industrial Hygienists
- 2) Air Contaminants, Federal Register, Vol. 54, No. 12, Thursday, 19, 1989, pp. 2513-2565.
- 3) In-house information
- 4) Technical judgment
- 5) Vendor information.

MSDS DATE: 8/14/95
CHANGE NO.: 14757For Assistance, Contact:
Regulatory Affairs Dept.
PO Box 987 Ames, IA 50010
(800) 227-4224HACH COMPANY
PO BOX 987
AMES, IA 50010Emergency Telephone #
Rocky Mountain Poison Ctr.
(303) 623-5716

08057

I. PRODUCT IDENTIFICATION

PRODUCT NAME: Sulfuric Acid 9.1000 ± 0.0005 M
CAS NO.: NA CHEMICAL NAME: Not applicable
FORMULA: Not applicable CHEMICAL FAMILY: Not applicable
MSDS NUMBER: M98357

II. INGREDIENTS

Sulfuric Acid
PCT: <1 CAS NO.: 7664-93-9 SARA: NOT LISTED
TLV: 1 mg/M3 PEL: 1 mg/M3
IARC: LISTED
HAZARD: Causes severe burns. Harmful if inhaled. Known carcinogenOther components, each
PCT: <0.1 CAS NO.: NA SARA: NOT LISTED
TLV: Not applicable PEL: Not applicable
HAZARD: Not applicableDemineralized Water
PCT: to 100 CAS NO.: 7732-18-6 SARA: NOT LISTED
TLV: Not applicable PEL: Not applicable
HAZARD: None

Any component of this mixture not specifically listed (eg. "other components") is not considered to present a carcinogen hazard.

III. PHYSICAL DATA

STATE: liquid APPEARANCE: Clear and colorless ODOR: None
SOLUBILITY IN: WATER: Miscible ACID: Miscible OTHER: Not determined
BOILING POINT: 140°C MELTING PT.: NA SPEC GRAVITY: 0.998 pH: 1.1
VAPOR PRESSURE: Not determined VAPOR DENSITY (air=1): ND
EVAPORATION RATE: 0.56 METAL CORROSIVITY - ALUMINUM: 0.124 in/yr
STEEL: 0.927 in/yr STABILITY: Stable
STORAGE PRECAUTIONS: Store tightly closed in a cool, dry place.

IV. FIRE, EXPLOSION HAZARD AND REACTIVITY DATA

FLASH PT.: Not applicable METHOD: NA
FLAMMABILITY LIMITS - LOWER: NA UPPER: NA
SUSCEPTIBILITY TO SPONTANEOUS HEATING: None
SHOCK SENSITIVITY: None AUTOIGNITION PT.: NA
EXTINGUISHING MEDIA: Not applicable
FIRE/EXPLOSION HAZARDS: None
HAZARDOUS DECOMP. PRODUCTS: None
OXIDIZER: No NFPA Codes: Health: 1 Flammability: 0 Reactivity: 0
CONDITIONS TO AVOID: Extreme temperatures

V. HEALTH HAZARD DATA

THIS PRODUCT MAY BE: Irritating to eyes.
ACUTE TOXICITY: Practically non-toxic
ROUTES OF EXPOSURE: Not determined
TARGET ORGANS: Not determined
CHRONIC TOXICITY: Not determined
ROUTES OF EXPOSURE: Not determined
TARGET ORGANS: Not determined
CANCER INFORMATION: An ingredient of this mixture is a known carcinogen.
ROUTES OF EXPOSURE: Inhalation
TARGET ORGANS: nasal cavity, paranasal sinus, lungs, larynx
OVEREXPOSURE: May cause eye irritation.
MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: None reported

VI. PRECAUTIONARY MEASURES

Avoid contact with eyes.
Wash thoroughly after handling.
PROTECTIVE EQUIPMENT: adequate ventilation, lab grade goggles, disposable
latex gloves, lab coat

VII. FIRST AID

EYE AND SKIN CONTACT: Immediately flush eyes with water for 15 minutes.
Call physician.
INGESTION: Give large quantities of water. Call physician immediately.
INHALATION: Not applicable

VIII. SPILL AND DISPOSAL PROCEDURES

IN CASE OF SPILL OR RELEASE: Cover the spill with excess soda ash or sodium bicarbonate. Suck slurry to beaker. Adjust pH to between 6 and 9. Flush to the drain with excess water. Wash site with an alkali solution.
DISPOSE OF IN ACCORDANCE WITH ALL FEDERAL, STATE, AND LOCAL REGULATIONS

IX. TRANSPORTATION DATA

D.O.T. PROPER SHIPPING NAME: Not Currently Regulated
HAZARD CLASS: NA ID: NA GROUP: NAI.C.A.O. PROPER SHIPPING NAME: Not Currently Regulated
HAZARD CLASS: NA ID: NA GROUP: NAI.M.O. PROPER SHIPPING NAME: Not Currently Regulated
HAZARD CLASS: NA ID: NA GROUP: NA

X. REFERENCES

- 1) TLV's Threshold Limit Values and Biological Exposure Indices for 1985. American Conference of Governmental Industrial Hygienists.
- 2) Air Contaminants, Federal Register, Vol. 54, No. 12, Thursday, Jan 14, 1989, pp. 2332-2983.
- 3) Technical judgment
- 4) In-house information
- 5) IARC Monographs on the Evaluation of Carcinogenic Risk to Humans, Health Organization (Volume 54) 1992, France.

SPECIAL NOTE: The IARC evaluation was based on exposure to the mist of concentrated sulfuric acid generated during chemical process.

CAT. NO. 943

MATERIAL SAFETY DATA SHEET

2431

MSDS DATE: 9/12/95
CHANGE NO.: 8748For Assistance, Contact:
Regulatory Affairs Dept.
PO Box 987 Ames, IA 50018
(800) 227-4224HACH COMPANY
PO BOX 987
AMES, IA 50010Emergency Telephone #
Rocky Mountain Poison Ctr.
(303) 423-5714

A8017

I. PRODUCT IDENTIFICATION

PRODUCT NAME: Bromocresol Green-Methyl Red
CAS NO.: NA CHEMICAL NAME: Not applicable
FORMULA: Not applicable CHEMICAL FAMILY: Not applicable
MSDS NUMBER: M80089

II. INGREDIENTS

Potassium Chloride
PCT: >98 CAS NO.: 7447-40-7 SARA: NOT LISTED
TLV: Not established PEL: Not established
HAZARD: May cause eye irritationOther components, each
PCT: <1 CAS NO.: NA SARA: NOT LISTED
TLV: Not applicable PEL: Not applicable
HAZARD: Not applicable

Any component of this mixture not specifically listed (e.g. "other components") is not considered to present a carcinogen hazard.

III. PHYSICAL DATA

STATE: solid APPEARANCE: Red-brown or green ODOR: None
SOLUBILITY IN: WATER: Soluble ACID: Not determined
OTHER: Not determined BOILING POINT: NA MELTING PT.: 181°C
SPEC GRAVITY: 1.91 pH: of 5% soln. = 9.9 VAPOR PRESSURE: Not applicable
VAPOR DENSITY (air=1): NA EVAPORATION RATE: NA
METAL CORROSIVITY - ALUMINUM: NO STEEL: NO
STABILITY: See Conditions to Avoid
STORAGE PRECAUTIONS: Store in a cool, dry place.

IV. FIRE, EXPLOSION HAZARD AND REACTIVITY DATA

FLASH PT.: Not applicable METHOD: NA
FLAMMABILITY LIMITS - LOWER: NA UPPER: NA
SUSCEPTIBILITY TO SPONTANEOUS HEATING: None
SHOCK SENSITIVITY: None AUTOIGNITION PT.: NI
EXTINGUISHING MEDIA: water, dry chemical, alcohol foam or carbon dioxide
FIRE/EXPLOSION HAZARDS: May emit toxic fumes in fire
HAZARDOUS DECOMP. PRODUCTS: May emit toxic chloride fumes in fire
OXIDIZER: No NFPA Codes: Health: 1 Flammability: 0 Reactivity: 0
CONDITIONS TO AVOID: Extreme heat; contact with acids.

V. HEALTH HAZARD DATA

THIS PRODUCT MAY BE: Irritating to eyes, skin and respiratory tract.

ACUTE TOXICITY: Moderately toxic
ROUTES OF EXPOSURE: Ingestion, Inhalation
TARGET ORGANS: circulatory systemCHRONIC TOXICITY: Not determined
ROUTES OF EXPOSURE: Not determined
TARGET ORGANS: Not determinedCANCER INFORMATION: Not applicable
ROUTES OF EXPOSURE: Not applicable
TARGET ORGANS: Not applicable

OVEREXPOSURE: May cause eye, skin and respiratory tract irritation. May

cause stomach disturbances, weakness, circulatory and heart problems.
MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: Persons with impaired kidney
function may be more susceptible to the effects of potassium chloride

VI. PRECAUTIONARY MEASURES

Avoid contact with eyes and skin.

Do not breathe dust.

Wash thoroughly after handling.

Keep away from acids.

PROTECTIVE EQUIPMENT: adequate ventilation, lab grade goggles, disposable
latex gloves

VII. FIRST AID

EYE AND SKIN CONTACT: Immediately flush eyes with water for 15 minutes;
physician. Flush skin with plenty of water.
INGESTION: Give large quantities of water. Call physician immediately.
INHALATION: Remove to fresh air.

VIII. SPILL AND DISPOSAL PROCEDURES

IN CASE OF SPILL OR RELEASE: Sweep up powder. Avoid breathing material.
Dissolve in water. Flush down the drain with excess water.
DISPOSE OF IN ACCORDANCE WITH ALL FEDERAL, STATE, AND LOCAL REGULATION

IX. TRANSPORTATION DATA

D.O.T. PROPER SHIPPING NAME: Not Currently Regulated
HAZARD CLASS: NA ID: NA GROUP: NAI.C.A.O. PROPER SHIPPING NAME: Not Currently Regulated
HAZARD CLASS: NA ID: NA GROUP: NAI.M.D. PROPER SHIPPING NAME: Not Currently Regulated
HAZARD CLASS: NA ID: NA GROUP: NA

X. REFERENCES

- 1) TLV's Threshold Limit Values and Biological Exposure Indices for 1983. American Conference of Governmental Industrial Hygienists.
- 2) Air Contaminants, Federal Register, Vol. 54, No. 12, Thursday, Jan 14, 1989, pp. 2532-2563.
- 3) In-house information
- 4) Technical judgment

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.

(C) HACH CO.

Hach Company, WORLD HEADQUARTERS, PO Box 309, Loveland, CO 80539

Hach Europe, BP 227, B5900 Nemur 1, BELGIUM

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96320

CHEMETRICS, INC. 10000 15th Avenue, N.W., 20138 540-788-4856 (FAX) 540-788-2026 540-788-4856 (Email) cheminfo@chemetrics.com	ChemMetrics, Inc. 10000 15th Avenue, N.W., 20138 540-788-4856 (FAX) 540-788-2026 540-788-4856 (Email) cheminfo@chemetrics.com
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MATERIAL SAFETY DATA SHEET

I. TRADENAMES: DISSOLVED OXYGEN CHEMetrics®, ULR CHEMetrics® and Vacu-Vials®

CATALOG NOS.: R-7501, R-7501U, R-7501V, R-7511, R-7518, R-7518U, R-7540, R-7540G, R-7540N, R-7540U, R-7540V, R-7553, K-7580U, K-7599 and K-7599V

DESCRIPTION: Reagent ampoules for the determination of dissolved oxygen in water. Each CHEMetric™ contains approximately 0.50 mL of liquid reagent sealed under vacuum. Each ULR CHEMetric™ contains approximately 1 mL of liquid reagent sealed under vacuum. Each Vacu-vial™ contains approximately 2 mL of liquid reagent sealed under vacuum.

NFPA RATINGS: HEALTH: 1 FLAMMABILITY: 0 REACTIVITY: 0

II. COMPONENTS

COMPONENT: Diethylene Glycol
CAS NO.: 111-46-8 PERCENT: 25.0

COMPONENT: Deionized Water
CAS NO.: 7732-18-5 PERCENT: >74.0

COMPONENT: Other components
CAS NO.: N/A PERCENT: < 1.0

Any component of this mixture not specifically listed (e.g. "other components") is not considered to present a carcinogen hazard.

III. PHYSICAL DATA

STATE: Liquid APPEARANCE: Colorless to pale yellow ODOR: None
SOLUBILITY IN WATER: Miscible pH: 11.5
BOILING POINT: 150°C MELTING POINT: -5.0°C
VAPOR PRESSURE: N/A SPECIFIC GRAVITY (H₂O = 1): 1.03
VAPOR DENSITY (AIR = 1): N/A

IV. FIRE AND EXPLOSION DATA

FLASH POINT: N/A AUTOIGNITION POINT: N/A
FLAMMABILITY LIMITS: UPPER: N/A LOWER: N/A
EXTINGUISHING MEDIA: Dry chemical, carbon dioxide, water spray or foam

V. REACTIVITY DATA

HAZARDOUS DECOMPOSITION PRODUCTS: None

VI. HEALTH HAZARD DATA

OSHA & ACGIH THRESHOLD LIMIT VALUE: None established
ACUTE TOXICITY: Irritation
CHRONIC TOXICITY: Irritation
CARCINOGEN STATUS: None
MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: May cause irritation to eyes, skin and mucous membranes.

VII. FIRST AID

EYE AND SKIN CONTACT: Immediately flush eyes and skin with water for 15 minutes.

INGESTION: Seek medical attention.

INHALATION: Remove individual to fresh air.

VIII. PRECAUTIONS

If this product is used as directed, the user will not come in contact with or be exposed to any of its chemical components.
Wash thoroughly after handling.

Avoid contact with eyes.

FRAGILE: Liquid in glass. Handle with care.

PROTECTIVE EQUIPMENT: Safety glasses

IX. SPILL AND DISPOSAL PROCEDURES

Take up with absorbent material. Place in small containers for disposal. Dispose of in accordance with all Federal, State and Local Regulations.

X. STORAGE CONDITIONS

Product should be stored in the dark and at room temperature; however, temperatures up to 120°F or even below freezing will not normally affect reagent performance.

THE ABOVE INFORMATION IS BELIEVED TO BE ACCURATE AND REPRESENTS THE BEST INFORMATION CURRENTLY AVAILABLE TO US. ALL PRODUCTS ARE OFFERED IN ACCORDANCE WITH THE MANUFACTURER'S CURRENT PRODUCTION SPECIFICATIONS AND ARE INTENDED SOLELY FOR USE IN ANALYTICAL TESTING. THE MANUFACTURER SHALL IN NO EVENT BE LIABLE FOR ANY INJURY, LOSS OR DAMAGE RESULTING FROM THE HANDLING, USE OR MISUSE OF THESE PRODUCTS.

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002916

MSDS
MATERIAL SAFETY DATA SHEET**SPEX**
Certiprep

Emergency Phone Number (24 hours) CHEMTREC: 1-800-424-9300

SECTION I**NAME:** Custom Anion Standard - Ion Chromatography Solution Standard: 1,000 ppm of Bromide (from Sodium Bromide) in water.**CHEMICAL FAMILY:** Dilute Salt Solution.**COMMON NAME OR SYNONYMS:** None.**SPEX CERTIPREP CATALOG NUMBER:** AS-BR9-2Y or AS-BR9-2X**PRECAUTIONARY DATA**

Since Br- is in solution at less than 10,000 ppm (or 1%), it is not required to be reported as Health Hazards according to OSHA.

This material is not known to contain any chemical listed as a carcinogen or suspected carcinogen at a concentration greater than 0.1% by OSHA, IARC, or NTP.

Use careful laboratory technique when working with any chemical whether it is considered a Health Hazard or not. Avoid inhalation, ingestion, and contact with the skin and eyes. Use protective gloves, glasses and clothing.

WHMIS Classification (Canada): Not regulated

SECTION II
PHYSICAL DATA**SPECIFIC GRAVITY:** Approximately 1.**SOLUBILITY IN WATER:** Soluble in water.**APPEARANCE AND ODOR:** Transparent solution without an odor.**NOTICE**

SPEX CERTIPREP, INC. ASSUMES NO RESPONSIBILITY AND MAKES NO WARRANTIES, EXPRESS OR IMPLIED, AS TO THE ACCURACY OR COMPLETENESS OF THE DATA CONTAINED HEREIN. INDICATED SAFETY MEASURES MAY NOT REFLECT ALL APPROPRIATE SAFETY MEASURES. SPEX CERTIPREP, INC. ASSUMES THAT ONLY QUALIFIED INDIVIDUALS, TRAINED AND FAMILIAR WITH PROCEDURES SUITABLE TO THIS PROCEDURE, WILL HANDLE THIS PRODUCT.

Date: March 20, 1997**Authorized Signature**
MSDS Coordinator

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TOTAL P.02

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

90983

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Date Printed 9/30/99
MSDS No: M00024

Material Safety Data Sheet

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Name: Ferrous Iron Reagent Powder Pillows
Catalog Number: 1037

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: M00024
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: 30
Month: August
Year: 1999

2. COMPOSITION / INFORMATION ON INGREDIENTS

1, 10-Phenanthroline

CAS No.: 5144-89-8
TSCA CAS Number: 66-71-7
Percent Range: 1.0 - 10.0
Percent Range Units: weight / weight
LD50: Oral Rat LD₅₀ = 132 mg/kg
LC50: None reported
TLV: Not established
PEL: Not established
Hazard: May cause irritation.

Sodium Bicarbonate

CAS No.: 144-55-8
TSCA CAS Number: 144-55-8
Percent Range: 90.0 - 100.0
Percent Range Units: weight / weight
LD50: Oral rat LD50 = 4220 mg/kg
LC50: None reported
TLV: Not established
PEL: Not established
Hazard: May cause irritation.

3. HAZARDS IDENTIFICATION

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Emergency Overview:

Appearance: White powder

Odor: Not determined

MAY CAUSE EYE, SKIN AND RESPIRATORY TRACT IRRITATION

HMIS:

Health: 1

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

Skin Absorption: None reported

Target Organs: None reported

Ingestion: Very large doses may cause: abdominal pain gastrointestinal disturbances alkalosis which causes abnormally high alkali reserve of the blood and other body fluids hypotension

Target Organs: None reported

Inhalation: May cause: respiratory tract irritation

Target Organs: None reported

Medical Conditions Aggravated: Pre-existing: Kidney conditions

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.

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): Give large quantities of water. Call physician immediately.

Inhalation: Remove to fresh air.

5. FIRE FIGHTING MEASURES

Flammable Properties: Does not burn, but may melt in a fire, releasing toxic fumes.

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: sodium monoxide nitrogen oxides. carbon monoxide, carbon dioxide.

Fire / Explosion Hazards: None reported

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: Stop spilled material from being released to the environment.

Clean-up Technique: Scoop up spilled material into a large beaker and dissolve with water. Flush the spilled material to the drain with a large excess of water. Decontaminate the area of the spill with a weak acid 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 skin Do not breathe dust. Wash thoroughly after handling. Maintain general industrial hygiene practices when using this product.

Storage: Keep container tightly closed when not in use. Protect from: moisture 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 Do not breathe: dust 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

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Appearance: White powder
Physical State: Solid
Molecular Weight: Not applicable
Odor: Not determined
pH: Not determined
Vapor Pressure: Not applicable
Vapor Density (air = 1): Not applicable
Boiling Point: Not applicable
Melting Point: Not determined
Specific Gravity (water = 1): 2.10
Evaporation Rate (water = 1): Not applicable
Volatile Organic Compounds Content: Not applicable
Partition Coefficient (n-octanol / water): Not applicable
Solubility:
 Water: Slightly soluble
 Acid: Slightly 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: Excess moisture Heating to decomposition.
Reactivity / Incompatibility: Incompatible with: oxidizers
Hazardous Decomposition: Toxic fumes of: nitrogen oxides sodium oxides carbon monoxide carbon dioxide
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: Sodium Bicarbonate: Eye - rabbit - 100 mg/30 seconds - MILD; Skin - Human - 30 mg/3 days intermittent - MILD
 Mutation Data: None reported
 Reproductive Effects Data: None reported
Ingredient Toxicological Data: Sodium Bicarbonate: Oral rat LD₅₀ = 4220 mg/kg; 1, 10-Phenanthroline: Oral rat LD₅₀ = 132 mg/kg

12. ECOLOGICAL INFORMATION

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

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(970) 669-3050

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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. Open cold water tap completely, slowly pour the 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

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

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

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MSDS No: M00024

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: Iron 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. 29 CFR 1900 - 1910 (Code of Federal Regulations - Labor). In-house information. 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.

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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CHEMETRICS INC 20100 E. 1st Avenue Suite 200 Denver, CO 80238 (303) 751-5025 (303) 751-5025 E-mail: info@chemetrics.com	CHEMETRICS INC 20100 E. 1st Avenue Suite 200 Denver, CO 80238 (303) 751-5025 (303) 751-5025 E-mail: info@chemetrics.com
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MATERIAL SAFETY DATA SHEET

I. CHEMICAL IDENTIFICATION

TRADE NAME: SULFIDE ACTIVATOR SOLUTION

CATALOG NO.: A-9500

DESCRIPTION: An accessory solution used in conjunction with reagent ampoules in the determination of sulfide in water. Each bottle contains approximately 10 mL of accessory solution.

NFPA RATINGS: HEALTH: 9 FLAMMABILITY: 0 REACTIVITY: 0

II. COMPOSITION/INFORMATION ON INGREDIENTS

COMPONENT: Ferric Chloride, Hexahydrate
CAS NO.: 10025-77-1 PERCENT: <30.0

COMPONENT: Hydrochloric Acid
CAS NO.: 7647-01-0 PERCENT: >70.0

III. HAZARDS IDENTIFICATION

DANGER! Corrosive. Causes eye and skin burns. Causes digestive and respiratory tract burns.

TARGET ORGANS: None

ACUTE TOXICITY: Irritation and burns

CHRONIC TOXICITY: Irritation and sensitization dermatitis

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: May cause irritation to eyes, skin and mucous membranes. May cause dermatitis, conjunctivitis, burns and teeth erosion.

IV. FIRST AID MEASURES

EYE AND SKIN CONTACT: Immediately flush eyes and skin with water for 15 minutes.

INGESTION: If conscious, give 2-4 cups of milk or water. Seek medical attention.

INHALATION: Remove individual to fresh air.

V. FIRE FIGHTING MEASURES

FLASH POINT: N/A AUTOIGNITION POINT: N/A

FLAMMABILITY LIMITS: UPPER: N/A LOWER: N/A

EXTINGUISHING MEDIA: Dry chemical, carbon dioxide or alcohol foam

VI. ACCIDENTAL RELEASE MEASURES

Take up with absorbent material. Place in small containers for disposal. Ventilate area and wash spill site after material pick up is complete.

VII. HANDLING AND STORAGE

If this product is used as directed, the user will not come in contact with or be exposed to any of its chemical components. Wash thoroughly after handling. Avoid contact with eyes.

Product should be stored in the dark and at room temperature; however, temperatures up to 120°F or even below freezing will not normally affect reagent performance.

VIII. EXPOSURE CONTROLS/ PERSONAL PROTECTION

OSHA & ACGIH THRESHOLD LIMIT VALUE: 5 ppm Hydrochloric Acid
PROTECTIVE EQUIPMENT: Safety glasses

IX. PHYSICAL AND CHEMICAL PROPERTIES

STATE: Liquid APPEARANCE: Brownish gold ODOR: Pungent
SOLUBILITY IN WATER: Miscible pH: <1
BOILING POINT: 198°C MELTING POINT: N/A
VAPOR PRESSURE: N/A SPECIFIC GRAVITY: 1.2
VAPOR DENSITY: 1.3

X. STABILITY AND REACTIVITY

HAZARDOUS DECOMPOSITION PRODUCTS: Emits toxic fumes. Heating releases increasing amounts of hydrogen chloride.

XI. TOXICOLOGICAL INFORMATION

Carcinogen Status (Hydrochloric Acid):

ACGIH: (A2) - suspected human carcinogen

NTP: Suspect carcinogen

OSHA: Possible select carcinogen

IARC: Group 3 carcinogen

XII. ECOLOGICAL INFORMATION

Environmental Fate: Substance will neutralize soil carbonate-based components.

XIII. DISPOSAL CONSIDERATIONS

Dispose of in a manner consistent with Federal, State and Local Regulations. Not listed as a material banned from land disposal according to RCRA.

XIV. TRANSPORT INFORMATION

US DOT: 49 CFR, 173.4 Exceptions For Small Quantities

IATA: Dangerous Goods In Excepted Quantities

Hazard Class: 8

UN Number: UN 1789

XV. REGULATORY INFORMATION

EUROPEAN INFORMATION:

Risk Phrases:

Corrosive. Causes Burns. Irritating to Respiratory System

Safety Phrases:

In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.

In case of accident or if you feel unwell, seek medical advice immediately (show label where possible).

U.S. INFORMATION:

All chemical components of this product are listed on the TSCA Inventory.

This material contains hydrochloric acid which is subject to the reporting requirements of Section 313 of SARA Title III and to CFR 373.

XVI. OTHER INFORMATION

THE ABOVE INFORMATION IS BELIEVED TO BE ACCURATE AND REPRESENTS THE BEST INFORMATION CURRENTLY AVAILABLE TO US. ALL PRODUCTS ARE OFFERED IN ACCORDANCE WITH THE MANUFACTURER'S CURRENT PRODUCTION SPECIFICATIONS AND ARE INTENDED SOLELY FOR USE IN ANALYTICAL TESTING. THE MANUFACTURER SHALL IN NO EVENT BE LIABLE FOR ANY INJURY, LOSS OR DAMAGE RESULTING FROM THE HANDLING, USE OR MISUSE OF THESE PRODUCTS.

MATERIAL SAFETY DATA SHEET

I. CHEMICAL IDENTIFICATION

TRADE NAMES: SULFIDE CHEMetrics®, VACUettes® and Vacu-vials®

CATALOG NOS.: R-9503, R-9510, R-9510A, R-9510B, R-9510C, R-9510D, R-9510J and R-9523

DESCRIPTION: Reagent ampoules for the determination of sulfide in water. Each CHEMetric™ and VACUette™ contains approximately 0.50 mL of liquid reagent sealed under vacuum. The R-9503 Vacu-vials® contain approximately 2 mL of liquid reagent sealed under vacuum. The R-9523 Vacu-vials® contain approximately 4.5 mL of liquid reagent sealed under vacuum.

NFPA RATINGS: HEALTH: 3 FLAMMABILITY: 0 REACTIVITY: 0

II. COMPOSITION/INFORMATION ON INGREDIENTS

COMPONENT: N,N-Dimethyl-p-phenylene diamine oxalate
CAS NO.: 62778-12-5 PERCENT: < 1.0

COMPONENT: Isopropyl Alcohol
CAS NO.: 67-63-0 PERCENT: 2.0

COMPONENT: Hydrochloric Acid
CAS NO.: 7647-01-0 PERCENT: 25.0

COMPONENT: Deionized Water
CAS NO.: 7732-18-5 PERCENT: >70.0

III. HAZARDS IDENTIFICATION

DANGER! Corrosive. Causes eye and skin burns. Causes digestive and respiratory tract burns.

TARGET ORGANS: None

ACUTE TOXICITY: Irritation and burns

CHRONIC TOXICITY: Irritation and sensitization dermatitis

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: May cause irritation to eyes, skin and mucous membranes. May cause dermatitis, conjunctivitis, burns and tooth erosion.

IV. FIRST AID MEASURES

EYE AND SKIN CONTACT: Immediately flush eyes and skin with water for 15 minutes

INGESTION: If conscious, give 2-4 cups of milk or water. Seek medical attention.

INHALATION: Remove individual to fresh air.

V. FIRE FIGHTING MEASURES

FLASH POINT: N/A AUTOIGNITION POINT: N/A

FLAMMABILITY LIMITS: UPPER: N/A LOWER: N/A

EXTINGUISHING MEDIA: Dry chemical, carbon dioxide or alcohol foam

VI. ACCIDENTAL RELEASE MEASURES

Take up with absorbent material. Place in small containers for disposal. Ventilate area and wash spill site after material pick up is complete.

VII. HANDLING AND STORAGE

If this product is used as directed, the user will not come in contact with or be exposed to any of its chemical components. Wash thoroughly after handling. Avoid contact with eyes.

FRAGILE: Liquid in glass. Handle with care.

Product should be stored in the dark and at room temperature; however, temperatures up to 120°F or even below freezing will not normally affect reagent performance.

VIII. EXPOSURE CONTROLS/ PERSONAL PROTECTION

OSHA & ACGIH THRESHOLD LIMIT VALUE: 5 ppm Hydrochloric Acid
PROTECTIVE EQUIPMENT: Safety glasses

IX. PHYSICAL AND CHEMICAL PROPERTIES

STATE: Liquid APPEARANCE: Colorless ODOR: Pungent

SOLUBILITY IN WATER: Miscible pH: <1

BOILING POINT: 150°C MELTING POINT: N/A

VAPOR PRESSURE: N/A SPECIFIC GRAVITY: 1.2

VAPOR DENSITY: N/A

X. STABILITY AND REACTIVITY

HAZARDOUS DECOMPOSITION PRODUCTS: Emits toxic fumes. Heating releases increasing amounts of hydrogen chloride.

XI. TOXICOLOGICAL INFORMATION

Carcinogen Status (Hydrochloric Acid):

ACGIH: (A2) - suspected human carcinogen

NTP: Suspect carcinogen

OSHA: Possible select carcinogen

IARC: Group 3 carcinogen

XII. ECOLOGICAL INFORMATION

Environmental Fate: Substance will neutralize soil carbonate-based components.

XIII. DISPOSAL CONSIDERATIONS

Dispose of in a manner consistent with Federal, State and Local Regulations. Not listed as a material banned from land disposal according to RCRA.

XIV. TRANSPORT INFORMATION

US DOT: 49 CFR, 173.4 Exceptions For Small Quantities

IATA: Dangerous Goods In Excepted Quantities

Hazard Class: 8

UN Number: UN 1789

XV. REGULATORY INFORMATION

EUROPEAN INFORMATION:

Risk Phrases:

Corrosive. Causes Burns. Irritating to Respiratory System

Safety Phrases:

In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.

In case of accident or if you feel unwell, seek medical advice immediately (show label where possible).

U.S. INFORMATION:

All chemical components of this product are listed on the TSCA inventory. This material contains hydrochloric acid which is subject to the reporting requirements of Section 313 of SARA Title III and to CFR 373.

XVI. OTHER INFORMATION

THE ABOVE INFORMATION IS BELIEVED TO BE ACCURATE AND REPRESENTS THE BEST INFORMATION CURRENTLY AVAILABLE TO US. ALL PRODUCTS ARE OFFERED IN ACCORDANCE WITH THE MANUFACTURER'S CURRENT PRODUCTION SPECIFICATIONS AND ARE INTENDED SOLELY FOR USE IN ANALYTICAL TESTING. THE MANUFACTURER SHALL IN NO EVENT BE LIABLE FOR ANY INJURY, LOSS OR DAMAGE RESULTING FROM THE HANDLING, USE OR MISUSE OF THESE PRODUCTS.

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00351

Fisher Scientific

Use your web browser's "Back" key to return to previous topic.

Sulfuric Acid

**** MATERIAL SAFETY DATA SHEET ****

Sulfuric Acid
22350

**** SECTION 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION ****

MSDS Name: Sulfuric Acid

Catalog Numbers:

S71211, S71211SC, S71826, S79200, S80213, S80213-1, A298 212, A298212, A300 212, A300 225LB, A300 500, A300 612GAL, A300 700LB, A300212, A300225LB, A300500, A300612GAL, A300700LB, A300C 212, A300C212, A300C212001, A300C212002, A300C212003, A300C212004, A300C212005, A300C212006, A300C212007, A300C212008, A300C212009, A300C212010, A300C212LC, A300FP 500, A300FP500, A300J500, A300P 500, A300P500, A300S 212, A300S 500, A300S212, A300S212LC, A300S500, A300SI 212, A300SI212, A468-1, A468-250, A468-500, A484 212, A484212, A510-212, A510-500, AC3000S212002, NC9466102, NC9499595, S71211MF, S71211MF*, S71211SCMF, S71211SCMF*, S79200MF, S79200MF* DHAZ, S79200MF*DHAZ, S79200SCMF, SA174 212, SA174 4, SA174212, SA1744, SA176 4, SA1764, SA196 500, SA196500

Synonyms:

Hydrogen Sulfate, Oil of Vitriol, Vitriol Brown Oil, Matting Acid, Battery Acid

Company Identification: Fisher Scientific
1 Reagent Lane
Fairlawn, NJ 07410

For information, call: 201-796-7100

Emergency Number: 201-796-7100

For CHEMTREC assistance, call: 800-424-9300

For International CHEMTREC assistance, call: 703-527-3887

**** SECTION 2 - COMPOSITION, INFORMATION ON INGREDIENTS ****

CAS#	Chemical Name	%	EINECS#
7664-93-9	Sulfuric acid	95-98.0%	231-639-5

Hazard Symbols: C
Risk Phrases: 35

**** SECTION 3 - HAZARD IDENTIFICATION ****

EMERGENCY VIEW

Appearance: colourless.

Danger! Strong oxidizer. Contact with other material may cause a fire. Corrosive. Harmful if swallowed. Causes eye and skin burns. May cause severe respiratory and digestive tract irritation with possible burns.

Target Organs: None.

Potential Health Effects

Eye:

Causes severe eye burns. May cause irreversible eye injury.

Skin:

Causes skin burns.

Ingestion:

May cause severe and permanent damage to the digestive tract. Causes gastrointestinal tract burns.

Inhalation:

Harmful if inhaled. May cause severe irritation of the respiratory tract with sore throat, coughing, shortness of breath and delayed lung edema. Causes chemical burn to the respiratory tract.

Chronic:

Prolonged or repeated inhalation may cause nosebleeds, nasal congestion, erosion of the teeth, perforation of the nasal septum, chest pain and bronchitis. Prolonged or repeated eye contact may cause conjunctivitis.

**** SECTION 4 - FIRST AID MEASURES ****

Eyes:

Flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower lids. Get medical aid immediately. Do NOT allow victim to rub or keep eyes closed.

Skin:

Get medical aid immediately. Flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. SPEEDY ACTION IS CRITICAL

Ingestion:

Do NOT induce vomiting. If victim is conscious and alert, give 2-4 cupfuls of milk or water. Never give anything by mouth to an unconscious person. Get medical aid immediately.

Inhalation:

Get medical aid immediately. Remove from exposure to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. DO NOT use mouth-to-mouth respiration.

Notes to Physician:

Treat symptomatically and supportively.

**** SECTION 5 - FIRE FIGHTING MEASURES ****

General Information:

Strong oxidizer. Contact with combustible materials may cause a fire. Wear appropriate protective clothing to prevent contact with skin and eyes. Wear a self-contained breathing apparatus (SCBA) to prevent contact with thermal decomposition products. Contact with water can cause violent liberation of heat and splattering of the material. Contact with metals may evolve flammable hydrogen gas. Containers may explode when heated or if contaminated with water.

Extinguishing Media:

Use carbon dioxide or dry chemical. Do NOT get water inside containers. Cool containers with flooding quantities of water until well after fire is out.

Autoignition Temperature: Not available

Flash Point: Not available.

(estimated) Health: 3; Flammability: 0; Reactivity: 2

Explosion Limits, Lower: Not available.

Upper: Not available.

**** SECTION 6 - ACCIDENTAL RELEASE MEASURES ****

General Information: Use proper personal protective equipment as indicated in Section 8.

Spills/Leaks:

Clean up spills immediately, observing precautions in the Protective Equipment section. Cover with sand, dry lime or soda ash and place in a closed container for disposal. Use water spray to reduce vapors, do not put water directly on leak, spill area or inside container.

**** SECTION 7 - HANDLING and STORAGE ****

Handling:

Wash thoroughly after handling. Remove contaminated clothing and wash before reuse. Do not get in eyes, on skin, or on clothing. Keep container tightly closed. Do not ingest or inhale. Do not allow contact with water. Use only in chemical fume hood.

Storage:

Do not store near combustible materials. Keep container closed when not in use. Store in a cool, dry, well-ventilated area away from incompatible substances. Do not store near alkaline substances.

**** SECTION 8 - EXPOSURE CONTROLS, PERSONAL PROTECTION ****

Engineering Controls:

Use process enclosure, local exhaust ventilation, or other engineering controls to control airborne levels below recommended exposure limits.

Exposure Limits

Chemical Name	ACGIH	NIOSH	OSHA - Final PELs
Sulfuric acid	1 mg/m ³ ; 3 mg/m ³ STEL	mg/m ³ TWA 15 mg/m ³ IDLH	1 mg/m ³ TWA

OSHA Vacated PELs:

Sulfuric acid:
1 mg/m³ TWA

Personal Protective Equipment

Eyes:

Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.

Skin:

Wear appropriate protective gloves to prevent skin exposure.

Clothing:

Wear appropriate protective clothing to prevent skin exposure.

Respirators:

Follow the OSHA respirator regulations found in 29CFR 1910.134 or European Standard EN 149. Always use a NIOSH or European Standard EN 149 approved respirator when necessary.

**** SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES ****

Physical State:

Liquid

Appearance:	colourless
Odor:	odorless
pH:	0.3 (1N Solution)
Vapor Pressure:	< .00120 mm Hg
Vapor Density:	1.2 kg/m3
Evaporation Rate:	Slower than ether.
Viscosity:	Negligible
Boiling Point:	554 deg F
Freezing/Melting Point:	50.6 deg F
Decomposition Temperature:	340 deg C
Solubility:	Soluble in water and ethanol.
Specific Gravity/Density:	1.841
Molecular Formula:	H2SO4
Molecular Weight:	98.0716

**** SECTION 10 - STABILITY AND REACTIVITY ****

Chemical Stability:

Stable under normal temperatures and pressures.

Conditions to Avoid:

Incompatible materials, contact with water, metals, excess heat, combustible materials, organic materials, oxidizers, amines, bases.

Incompatibilities with Other Materials:

Acetic Anhydride, Acetone Cyanhydrin, Acetone + Nitric Acid, Acetone + Potassium Dichromate, Acetonitrile + sulfur trioxide, Acrolein, Acrylonitrile, Alcohols + Hydrogen Peroxide, Allyl Alcohol, Allyl Chloride, 2-Aminoethanol, Ammonium Hydroxide Ammonium iron(III) sulfate dodecahydrate, Ammonium trichromate, Aniline + Glycerol + Nitrobenzene, Benzyl Alcohol, Bromates + Metals, tert-Butyl-m-xylene + Nitric Acid, 1-Chloro-2,3-epoxypropane, Bromine Pentafluoride, n-Butyraldehyde, Carbides, Cesium Acetylene Carbide, Chlorates, 4-Chloronitrobenzene + sulfur trioxide, Copper, Dichloromethane + Ethanol + Nitrate or Nitrite, 2-Cyano-4-nitrobenzenediazonium hydrogen sulfate, 2-cyano-2-propanol, Chlorine Trifluoride, Chlorosulfonic Acid, Cyclopentadiene, Cyclopentanone oxime, 1,3-Diazidobenzene, Diethylamine, Cuprous Nitride, Diisobutylene, Epichlorohydrin, Ethylene Cyanohydrin, Ethylene Diamine, Ethylene Glycol, Dimethoxydinitroanthraquinone, 4-Dimethylaminobenzaldehyde, 2,5-Dinitro-3-Methylbenzoic acid + Sodium Azide, 1,5-Dinitronaphthalene + Sulfur, Ethoxylated nonylphenol, Hexalithium disilicide, Ethylenimine, Fulminates, Other Acids, Iodine Heptafluoride, Metals, Isoprene, Hydrofluoric acid, Hydrogen peroxide, Metal acetylides or carboles, Metal Chlorates, Metal Perchlorates, 4-Methylpyridine, Nitramide, Nitric Acid + Organic Materials, Nitric Acid + Toluene, Nitroaryl bases and derivatives, Nitrobenzene, 3-Nitrobenzenesulfonic Acid, Nitromethane, N-Nitromethylamine, 4-Nitrotoluene, Permanganates, Phosphorus, Phosphorus (III) Oxide, Poly(silylene), Mercuric Nitride, Mesityl Oxide, p-Nitrotoluene, Pentasilver Trihydroxydiaminophosphate, Perchlorates, Permanganates + Benzene, Phosphorus Isocyanate, Picrates, Potassium t-Butoxide, Potassium, 3-Propynol, Potassium Chlorate, Permanganates, beta-Proplactone, Propylene Oxide, Pyridine, Rubidium Acetylene Carbide and Sodium, Silver Permanganates, Silver Peroxochromate, Sodium, Sodium Carbonate, Sodium Tetrahydroborate, Sodium Thiocyanate, Sucrose, Tetramethylbenzenes, 1,2,4,5-Tetrazine, Thallium (I) azidodithiocarbonate, 1,3,5-Triazaicosahydro-1,3,5-triazine, Water, and Zinc Iodide.

Hazardous Decomposition Products:

Oxides of sulfur.

Hazardous Polymerization: Has not been reported.

**** SECTION 11 - TOXICOLOGICAL INFORMATION ****

RTECS#:

CAS# 7664-93-9: WS5600000
LD50/LC50:
CAS# 7664-93-9: Inhalation, mouse: LC50 = 320 mg/m3/2H; Inhalation,
rat: LC50 = 510 mg/m3/2H; Oral, rat: LD50 = 2140 mg/kg.
Carcinogenicity:
Sulfuric acid -
ACGIH: (contained in strong inorganic acid mists): A2 - Suspected
OSHA: Select carcinogen
IARC: Group 1 carcinogen
Epidemiology:
Workers exposed to industrial sulfuric acid mist showed a statistical increase in laryngeal cancer. This data suggests a possible relationship between carcinogenesis and inhalation of sulfuric acid mist.
Teratogenicity:
No data available.
Reproductive Effects:
No data available.
Neurotoxicity:
No data available.
Mutagenicity:
No data available.
Other Studies:
No data available.

**** SECTION 12 - ECOLOGICAL INFORMATION ****

Ecotoxicity:
Sulfuric acid is harmful to aquatic life in very low concentrations. It may be dangerous if it enters water intakes. The aquatic toxicity for bluegill in fresh water was 24.5 ppm/24 hr, which was lethal.
Environmental Fate:
Not available.
Physical/Chemical:
Not available.
Other:
Not available.

**** SECTION 13 - DISPOSAL CONSIDERATIONS ****

Dispose of in a manner consistent with federal, state, and local regulations.
RCRA D-Series Maximum Concentration of Contaminants:
None listed.
RCRA D-Series Chronic Toxicity Reference Levels: None listed.
RCRA F-Series: None listed.
RCRA P-Series: None listed.
RCRA U-Series: None listed.
Not listed as a material banned from land disposal according to RCRA.

**** SECTION 14 - TRANSPORT INFORMATION ****

US DOT
Shipping Name: SULFURIC ACID
Hazard Class: 8
UN Number: UN1830
Packing Group: II
IMO
No information available.
IATA
No information available.
RID/ADR
No information available.
Canadian TDG

Shipping Name: SULFURIC ACID
Hazard Class: 8(9.2)
UN Number: UN1830

**** SECTION 15 - REGULATORY INFORMATION ****

US FEDERAL

TSCA

CAS# 7664-93-9 is listed on the TSCA inventory.

Health & Safety Reporting List

None of the chemicals are on the Health & Safety Reporting List.

Chemical Test Rules

None of the chemicals in this product are under a Chemical Test Rule.

Section 12b

None of the chemicals are listed under TSCA Section 12b.

TSCA Significant New Use Rule

None of the chemicals in this material have a SNUR under TSCA.

SARA

Section 302 (RQ)

CAS# 7664-93-9: final RQ = 1000 pounds (454 kg)

Section 302 (TPQ)

CAS# 7664-93-9: TPQ = 1000 pounds; RQ = 1000 pounds

SARA Codes

CAS # 7664-93-9: acute, chronic, reactive.

Section 313

This material contains Sulfuric acid (CAS# 7664-93-9, 95.98%), which is subject to the reporting requirements of Section 313 of SARA Title III and 40 CFR Part 373.

Clean Air Act:

This material does not contain any hazardous air pollutants.

This material does not contain any Class 1 Ozone depleters.

This material does not contain any Class 2 Ozone depleters.

Clean Water Act:

CAS# 7664-93-9 is listed as a Hazardous Substance under the CWA.

None of the chemicals in this product are listed as Priority

Pollutants under the CWA.

None of the chemicals in this product are listed as Toxic Pollutants under the CWA.

OSHA:

None of the chemicals in this product are considered highly hazardous by OSHA.

STATE

Sulfuric acid can be found on the following state right to know lists: California, New Jersey, Florida, Pennsylvania, Minnesota, Massachusetts.

California No Significant Risk Level

None of the chemicals in this product are listed.

European/International Regulations

European Labeling in Accordance with EC Directives

Hazard Symbols: C

Risk Phrases:

R 35 Causes severe burns.

Safety Phrases:

S 26 In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.

S 30 Never add water to this product.

S 45 In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

WGK (Water Danger/Protection)

CAS# 7664-93-9: 2

Canada

CAS# 7664-93-9 is listed on Canada's DSL/NDSL List.

This product has a WHMIS classification of C, D1A, E.

CAS# 7664-93-9 is not listed on Canada's Ingredient Disclosure List.

Exposure Limits

CAS# 7664-93-9: OEL-ARAB Republic of Egypt:TWA 1 mg/m3. OEL-AUSTRALIA:TWA 1 mg/m3. OEL-BELGIUM:TWA 1 mg/m3;STEL 3 mg/m3. OEL-CZECHOSLOVAKIA:TWA 1 mg/m3;STEL 2 mg/m3. OEL-DENMARK:TWA 1 mg/m3. OEL-FINLAND:TWA 1 mg/m3;STEL 3 mg/m3;Skin. OEL-FRANCE:TWA 1 mg/m3;STEL 3 mg/m3. OEL-GERMANY:TWA 1 mg/m3. OEL-HUNGARY:STEL 1 mg/m3. OEL-JAPAN:TWA 1 mg/m3. OEL-THE NETHERLANDS:TWA 1 mg/m3. OEL-THE PHILIPPINES:TWA 1 mg/m3. OEL-POLAND:TWA 1 mg/m3. OEL-RUSSIA:STEL 1 mg/m3;Skin. OEL-SWEDEN:TWA 1 mg/m3;STEL 3 mg/m3. OEL-SWITZERLAND:TWA 1 mg/m3;STEL 2 mg/m3. OEL-THAILAND:TWA 1 mg/m3. OEL-TURKEY:TWA 1 mg/m3. OEL-UNITED KINGDOM:TWA 1 mg/m3. OEL IN BULGARIA, COLOMBIA, JORDAN, KOREA check ACGIH TLV. OEL IN NEW ZEALAND, SINGAPORE, VIETNAM check ACGIH TLV

**** SECTION 16 - ADDITIONAL INFORMATION ****

MSDS Creation Date: 12/28/1994 Revision #23 Date: 12/12/1997

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no way shall Fisher be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if Fisher has been advised of the possibility of such damages.

09870
MATERIAL SAFETY DATA SHEET (MSDS)**MATERIAL SAFETY DATA SHEET****EM SCIENCE****SCANNED**
Oct 20 1999**1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION****Manufacturer.....:**

EM SCIENCE
A Division of EM Industries
P.O. Box 70
480 Democrat Road
Gibbstown, N.J. 08027

Preparation Date.: 8/27/98

Information Phone Number.: 856-423-6300
Hours: Mon. to Fri. 8:30-5
Chemtec Emergency Number: 800-424-9300
Hours: 24 hrs a day

Catalog Number(s):

0003147W 00031487 314 315 317 321 HX0603 HX0603I
HX0603P HX0603PS HX0603T HX0603TP HX0603Y HX0606
HX0607

Product Name:

Hydrochloric Acid

Synonyms:

Muriatic Acid, 23 deg. Be

Chemical Family:

Inorganic Acid

Formula:

HCl

Molecular Weight.:

36.46

2. COMPOSITION / INFORMATION ON INGREDIENTS

Component	CAS #	Appr %
Hydrochloric Acid	7647-01-0	100%

Approximate per cent indicates that this product is a concentrated acid. Hydrochloric acid is approximately 37%.

3. HAZARDS IDENTIFICATION**EMERGENCY OVERVIEW**

CAUSES SEVERE BURNS.

MAY BE FATAL IF INHALED OR SWALLOWED.

VAPOR EXTREMELY IRRITATING.

May Cause Damage To Respiratory Passages and Lungs.

Appearance:

Clear, colorless liquid; acrid odor

POTENTIAL HEALTH EFFECTS (ACUTE AND CHRONIC)

Symptoms of Exposure:

Eye contact causes severe burns and permanent eye damage. Skin contact causes severe burns, possible deep ulceration. Inhalation causes damage to nasal and respiratory passages, pulmonary edema. Ingestion causes burns of mouth, throat and gastrointestinal tract.

Medical Cond. Aggravated by Exposure:

Respiratory conditions

Routes of Entry:

Inhalation, ingestion or skin contact.

Carcinogenicity:

The material is not listed (IARC, NTP, OSHA) as cancer causing agent.

4. FIRST AID MEASURES

Emergency First Aid:

GET MEDICAL ASSISTANCE FOR ALL CASES OF OVEREXPOSURE.

Skin: Immediately flush thoroughly with large amounts of water.

Eyes: Immediately flush thoroughly with water for at least 15 minutes.

Inhalation: Remove to fresh air; give artificial respiration if breathing has stopped.

Ingestion: do not induce vomiting; give water or milk if conscious; get medical attention.

5. FIRE FIGHTING MEASURES

Flash Point (F): Noncombustible

Flammable Limits LEL (%): N/A

Flammable Limits UEL (%): N/A

Extinguishing Media:

Water spray

Fire Fighting Procedures:

Wear self-contained breathing apparatus and protective clothing.

Fire & Explosion Hazards:

Contact with metals produces hydrogen which may form explosive mixtures with air.

6. ACCIDENTAL RELEASE MEASURES

Spill Response:

Evacuate the area of all unnecessary personnel. Wear suitable protective equipment listed under Exposure / Personal Protection. Eliminate any ignition sources until the area is determined to be free from explosion or fire hazards. Contain the release and eliminate its source, if this can be done without risk. Take up and containerize for proper disposal as described under Disposal. Comply with Federal, State, and local regulations on reporting releases. Refer to Regulatory Information for reportable quantity and other regulatory data.

EM SCIENCE recommends SPILL-X neutralizers and absorbent agents for various types of spills.

Additional information on the SPILL-X products can be provided through the EM SCIENCE Technical Service Department (609) 423-6300. The following EM SCIENCE SPILL-X neutralizer and absorbent is recommended for this product:

SX0861 Spill-X-A Acid Spill Treatment Kit

7. HANDLING AND STORAGE

Handling & Storage:

Keep container tightly closed. Store in a cool, well-ventilated area separated from incompatible materials. Do not breathe vapor. Do not get in eyes, on skin, or on clothing. Handle empty containers with caution. Add acid cautiously to water when diluting - never add water to acid.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

ENGINEERING CONTROLS AND PERSONAL PROTECTIVE EQUIPMENT:

Ventilation, Respiratory Protection, Protective Clothing, Eye Protection:

Respiratory Protection: If workplace exposure limit(s) of product or any component is exceeded (see TLV/PEL), a NIOSH/MSHA approved air supplied respirator is advised in absence of proper environmental control. OSHA regulations also permit other NIOSH/MSHA respirators (negative pressure type) under specified conditions (see your safety equipment supplier). Engineering and/or administrative controls should be implemented to reduce exposure. Material must be handled or transferred in an approved fume hood or with equivalent ventilation. Protective gloves (Neoprene, Nitrile or equivalent) must be worn to prevent skin contact. Safety glasses with side shields must be worn at all times.

Work/Hygenic Practices:

Wash thoroughly after handling. Do not take internally. Eye wash and safety equipment should be readily available.

EXPOSURE GUIDELINES

OSHA - PEL:

Component	TWA		STEL		CL		Skin
	PPM	MG/M3	PPM	MG/M3	PPM	MG/M3	
Hydrochloric Acid					5	7	

ACGIH - TLV:

Component	TWA		STEL		CL		Skin
	PPM	MG/M3	PPM	MG/M3	PPM	MG/M3	
Hydrochloric Acid			5	7.5	5	7.5	

If there are no exposure limit numbers listed in the Exposure Guidelines chart, this indicates that no OSHA or ACGIH exposure limits have been established.

9. PHYSICAL AND CHEMICAL PROPERTIES

Boiling Point (C 760 mmHg) : 110C 20.24%
Melting Point (C) : -74C
Specific Gravity (H₂O = 1) : 1.1885
Vapor Pressure (mm Hg) : 160 20C
Percent Volatile by vol (%) : 99.9+%
Vapor Density (Air = 1) : 1.25
Evaporation Rate (BuAc = 1) : 2.0
Solubility in Water (%) : Miscible
Appearance :
Clear, colorless liquid; acrid odor

10. STABILITY AND REACTIVITY

Stability: Yes

Hazardous Polymerization:
Does not occur

Hazardous Decomposition:
Toxic hydrogen chloride gas

Conditions to Avoid:
Heat; contact with metals.

Materials To Avoid:

- () Water
- () Acids
- (X) Bases
- () Corrosives
- () Oxidizers
- (X) Other: Alkalies and amines; contact with metals
produces hydrogen

11. TOXICOLOGICAL INFORMATION

Toxicity Data

ihl-hmn LDLo: 1300 ppm/30M
orl-rbt LD50: 900 mg/kg

Toxicological Findings:
Test on laboratory animals indicate material may produce adverse mutagenic and reproductive effects.
Cited in Registry of Toxic Effects of Chemical Substances (RTECS)

12. DISPOSAL CONSIDERATIONS

EPA Waste Numbers: D002

Treatment:

Specified Technology - Neutralize to pH 6-9. Contact your local permitted waste disposal site (TSD) for permissible treatment sites.

ALWAYS CONTACT A PERMITTED WASTE DISPOSER (TSD) TO ASSURE COMPLIANCE WITH ALL CURRENT LOCAL, STATE AND FEDERAL REGULATIONS.

13. TRANSPORT INFORMATION

DOT Proper Shipping Name:
Hydrochloric Acid

DOT ID Number :
UN1789

14. REGULATORY INFORMATION

TSCA Statement:

This product is a "Mixture". The CAS numbers of all components are listed on the TSCA Inventory.

Component	SARA EHS (302)	SARA EHS TPQ (lbs)	CERCLA RQ (lbs)
Hydrochloric Acid	Y	500	5000

Component	OSHA Floor List	SARA 313	DeMinimis for SARA 313 (%)
Hydrochloric Acid	Y	Y	1.0

If there is no information listed on the regulatory information chart, this indicates that the chemical is not covered by the specific regulation listed.

15. OTHER INFORMATION

Comments:

None

NFPA Hazard Ratings:

Health : 3
Flammability : 0
Reactivity : 0
Special Hazards :

Revision History: 11/1/83 3/1/84 11/1/84 12/8/86
10/27/87 2/20/90 3/1/91 11/26/91 12/8/92 4/27/93
3/3/94 3/9/95 1/31/97 3/18/97

| = Revised Section

N/A = Not Available

N/E = None Established

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Please reduce your browser font size for better viewing and printing.

MSDS**Material Safety Data Sheet**

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

MALLINCKRODT

24 Hour Emergency Telephone: 908-959-2151
CHEMTREC: 1-800-424-6300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 202-483-7618

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

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

FORMALDEHYDE

MSDS Number: F5522 --- Effective Date: 03/23/98

1. Product Identification

Synonyms: Formaldehyde 37%; Formalin; Morbicide Acid; Methylene Oxide; Methyl aldehyde

CAS No.: 50-00-0

Molecular Weight: 30.03

Chemical Formula: HCHO and CH₃OH in water

Product Codes:

J.T. Baker: 2105, 2106, 2107

Mallinckrodt: 5014, 5016

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Formaldehyde	50-00-0	37%	Yes
Methyl Alcohol	67-56-1	10 - 15%	Yes
Water	7732-18-5	48 - 53%	No

3. Hazards Identification

Emergency Overview

POISON! DANGER! SUSPECT CANCER HAZARD. MAY CAUSE CANCER. Risk of cancer depends on level and duration of exposure. **VAPOR HARMFUL. HARMFUL IF INHALED OR ABSORBED THROUGH SKIN. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. STRONG SENSITIZER. MAY BE FATAL OR CAUSE BLINDNESS IF SWALLOWED.**

CANNOT BE MADE NONPOISONOUS. FLAMMABLE LIQUID AND VAPOR.**J.T. Baker SAF-T-DATA^(tm) Ratings (Provided here for your convenience)**

Health Rating: 3 - Severe (Cancer Causing)

Flammability Rating: 2 - Moderate

Reactivity Rating: 2 - Moderate

Contact Rating: 3 - Severe (Corrosive)

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

Storage Color Code: Red (Flammable)

Potential Health Effects

The perception of formaldehyde by odor and eye irritation becomes less sensitive with time as one adapts to formaldehyde. This can lead to overexposure if a worker is relying on formaldehyde's warning properties to alert him or her to the potential for exposure.

Inhalation:

May cause sore throat, coughing, and shortness of breath. Causes irritation and sensitization of the respiratory tract. Concentrations of 25 to 30 ppm cause severe respiratory tract injury leading to pulmonary edema and pneumonitis. May be fatal in high concentrations.

Ingestion:

Can cause severe abdominal pain, violent vomiting, headache, and diarrhea. Larger doses may produce decreased body temperature, pain in the digestive tract, shallow respiration, weak irregular pulse, unconsciousness and death. Methanol component affects the optic nerve and may cause blindness.

Skin Contact:

Toxic. May cause irritation to skin with redness, pain, and possibly burns. Skin absorption may occur with symptoms paralleling those from ingestion. Formaldehyde is a severe skin irritant and sensitizer. Contact causes white discoloration, smarting, cracking and scaling.

Eye Contact:

Vapors cause irritation to the eyes with redness, pain, and blurred vision. Higher concentrations or splashes may cause irreversible eye damage.

Chronic Exposure:

Frequent or prolonged exposure to formaldehyde may cause hypersensitivity leading to contact dermatitis. Repeated or prolonged skin contact with formaldehyde may cause an allergic reaction in some people. Vision impairment and enlargement of liver may occur from methanol component. Formaldehyde is a suspected carcinogen (positive animal inhalation studies).

Aggravation of Pre-existing Conditions:

Persons with pre-existing skin disorders or eye problems, or impaired liver, kidney or respiratory function may be more susceptible to the effects of the substance. Previously exposed persons may have an allergic reaction to future exposures.

4. First Aid Measures**Inhalation:**

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

Ingestion:

If swallowed and the victim is conscious, dilute, inactivate, or absorb the ingested

formaldehyde by giving milk, activated charcoal, or water. Any organic material will inactivate formaldehyde. Keep affected person warm and at rest. Get medical attention immediately. If vomiting occurs, keep head lower than hips.

Skin Contact:

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

Eye Contact:

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

Note to Physician:

Monitor arterial blood gases and methanol levels after significant ingestion. Hemodialysis may be effective in formaldehyde removal. Use formic acid in urine and formaldehyde in blood or expired air as diagnostic tests.

5. Fire Fighting Measures

Fire:

Flash point: 60C (140F) CC

Autoignition temperature: 300C (572F)

Flammable limits in air % by volume:

lcl: 7.0; ucl: 73

Flammable liquid and vapor! Gas vaporizes readily from solution and is flammable in air.

Explosion:

Above flash point, vapor-air mixtures are explosive within flammable limits noted above.

Containers may explode when involved in a fire.

Fire Extinguishing Media:

Water spray, dry chemical, alcohol foam, or carbon dioxide.

Special Information:

In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Water may be used to flush spills away from exposures and to dilute spills to non-flammable mixtures.

6. Accidental Release Measures

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

7. Handling and Storage

Store in a tightly closed container. Protect against physical damage. Store in a cool, dry well-ventilated location, away from any area where the fire hazard may be acute. Outside or detached storage is preferred. Separate from incompatibles. Containers should be bonded and grounded for transfers to avoid static sparks. Storage and use areas should be No Smoking areas. Use non-sparking type tools and equipment, including explosion proof ventilation. Wear special protective equipment (Sec. 8) for maintenance break-in or where exposures may exceed established exposure levels. Wash hands, face, forearms and neck when exiting restricted areas. Shower, dispose of outer clothing, change to clean garments at the end of the day. Avoid cross-contamination of street clothes. Wash hands before eating and do not eat, drink, or smoke in workplace. Protect from freezing. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:

-OSHA Permissible Exposure Limit (PEL):

0.75 ppm (TWA), 2 ppm (STEL), 0.5 ppm (TWA) action level for formaldehyde
200 ppm (TWA) for methanol

-ACGIH Threshold Limit Value (TLV):

0.3 ppm Ceiling formaldehyde, A2 Suspected Human Carcinogen
200 ppm (TWA) 250 ppm (STEL) skin for methanol

Ventilation System:

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

Personal Respirators (NIOSH Approved):

If the exposure limit is exceeded, a full facepiece respirator with a formaldehyde cartridge may be worn up to 50 times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. For emergencies or instances where the exposure levels are not known, use a full-facepiece positive-pressure, air-supplied respirator. WARNING: Air purifying respirators do not protect workers in oxygen-deficient atmospheres. Irritation also provides warning. For Methanol: If the exposure limit is exceeded, wear a supplied air, full-facepiece respirator, airlined hood, or full-facepiece self-contained breathing apparatus.

Skin Protection:

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

Eye Protection:

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

Other Control Measures:

See OSHA Standard for more information on personal protective equipment, engineering and work practice controls, medical surveillance, record keeping, and reporting requirements. (29 CFR 1910.1048)

9. Physical and Chemical Properties

Appearance:

Clear, colorless liquid.

Odor:

Pungent odor.

Solubility:

Infinitely soluble.

Specific Gravity:

1.08

pH:

2.8 (31% solution)

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

100

Boiling Point:

96C (205F)

Melting Point:

-15C (5F)

Vapor Density (Air=1):

1.04

Vapor Pressure (mm Hg):

1.3 @ 20C (68F)

Evaporation Rate (BuAc=1):

No information found.

10. Stability and Reactivity

Stability:

Stable under ordinary conditions of use and storage.

Hazardous Decomposition Products:

May form carbon dioxide, carbon monoxide, and formaldehyde when heated to decomposition.

Hazardous Polymerization:

Trioxymethylene precipitate can be formed on long standing at very low temperatures.

Nonhazardous polymerization may occur at low temperatures, forming paraformaldehyde, a white solid.

Incompatibilities:

Incompatible with oxidizing agents and alkalis. Reacts explosively with nitrogen dioxide at ca. 180C (356F). Reacts violently with perchloric acid, perchloric acid-aniline mixtures, and nitromethane. Reaction with hydrochloric acid may form bis-chloromethyl ether, an OSHA regulated carcinogen.

Conditions to Avoid:

Heat, flames, ignition sources and incompatibles.

11. Toxicological Information

Formaldehyde: Oral rat LD50: 100 mg/kg; skin rabbit LD50: 270 uL/kg, Irritation data: eye, rabbit, 750ug Severe; inhalation rat LC50: 203 mg/m3; investigated as a tumorigen, mutagen, reproductive effector; Cancer Status: an OSHA regulated carcinogen. Methanol: oral rat LD50: 5628 mg/kg; inhalation rat LC50: 64000 ppm/4H; skin rabbit LD50: 15800 mg/kg; investigated as a tumorigen, mutagen, reproductive effector.

-----\Cancer Lists\-----			
Ingredient	---NTP Carcinogen---		IARC Category
	Known	Anticipated	
Formaldehyde (50-00-0)	No	Yes	2A
Methyl Alcohol (67-56-1)	No	No	None
Water (7732-18-5)	No	No	None

12. Ecological Information

Environmental Fate:

The following statements refer to the environmental fate of formaldehyde. When released into the soil, this material is expected to leach into groundwater. When released into water, this material is expected to readily biodegrade. When released into water, this material is not expected to evaporate significantly. This material is not expected to significantly bioaccumulate. When released into the air, this material is expected to be readily degraded by reaction with photochemically produced hydroxyl radicals. When released into the air, this material is expected to be readily degraded by photolysis. When released into the air, this material is expected to be readily removed from the atmosphere by dry and wet deposition. When released into the air, this material is expected to have a half-life of less than 1 day. The following statements refer to the environmental fate of methanol. When released into the soil, this material is expected to readily biodegrade. When released into the soil, this material is expected to leach into groundwater. When released into the soil, this material is expected to quickly evaporate. When released into water, this material is expected to readily biodegrade. When released into the water, this material is expected to have a half-life between 1 and 10 days. When released into the air, this material is expected to be readily degraded by reaction with photochemically produced hydroxyl radicals. When released into the air, this material is expected to be readily removed from the atmosphere by wet deposition. When released into air, this material is expected to have a half-life between 10 and 30 days.

Environmental Toxicity:

The following toxicity information is for the formaldehyde portion. This material is expected to be slightly toxic to aquatic life. The LC50/96-hour values for fish are between 10 and 100 mg/l. The methanol portion is expected to be slightly toxic to aquatic life. The LC50/96-hour values for fish are between 10 and 100 mg/l.

13. Disposal Considerations

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

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: RQ, FORMALDEHYDE, SOLUTION, FLAMMABLE

Hazard Class: 3, 8
UN/NA: UN1198
Packing Group: III
Information reported for product/size: 475LB

International (Water, I.M.O.)

Proper Shipping Name: FORMALDEHYDE SOLUTIONS
Hazard Class: 3.3, 8
UN/NA: UN1198
Packing Group: III
Information reported for product/size: 475LB

15. Regulatory Information

-----\Chemical Inventory Status - Part 1\-----				
Ingredient	TSCA	EC	Japan	Australia
Formaldehyde (50-00-0)	Yes	Yes	Yes	Yes
Methyl Alcohol (67-56-1)	Yes	Yes	Yes	Yes
Water (7732-18-5)	Yes	Yes	Yes	Yes

-----\Chemical Inventory Status - Part 2\-----				
Ingredient	Korea	--Canada--		
		DSL	NDSL	Phil.
Formaldehyde (50-00-0)	Yes	Yes	No	Yes
Methyl Alcohol (67-56-1)	Yes	Yes	No	Yes
Water (7732-18-5)	Yes	Yes	No	Yes

-----\Federal, State & International Regulations - Part 1\-----				
Ingredient	-SARA 302-		-----SARA 313-----	
	RQ	TPQ	List	Chemical Catg.
Formaldehyde (50-00-0)	100	500	Yes	No
Methyl Alcohol (67-56-1)	No	No	Yes	No
Water (7732-18-5)	No	No	No	No

-----\Federal, State & International Regulations - Part 2\-----			
Ingredient	CERCLA	-RCRA-	-TSCA-
		261.33	8(d)
Formaldehyde (50-00-0)	100	U122	No
Methyl Alcohol (67-56-1)	5000	U154	No
Water (7732-18-5)	No	No	No

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

WARNING:

THIS PRODUCT CONTAINS A CHEMICAL(S) KNOWN TO THE STATE OF CALIFORNIA TO CAUSE CANCER.

Australian Hazchem Code: 2SE

Poison Schedule: S6

WHMIS:

This MSDS has been prepared according to the hazard criteria of the Controlled Products

Regulations (CPR) and the MSDS contains all of the information required by the CPR.

16. Other Information

NFPA Ratings: Health: 3 Flammability: 2 Reactivity: 0

Label Hazard Warning:

POISON! DANGER! SUSPECT CANCER HAZARD. MAY CAUSE CANCER. Risk of cancer depends on level and duration of exposure. VAPOR HARMFUL. HARMFUL IF INHALED OR ABSORBED THROUGH SKIN. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. STRONG SENSITIZER. MAY BE FATAL OR CAUSE BLINDNESS IF SWALLOWED. CANNOT BE MADE NONPOISONOUS. FLAMMABLE LIQUID AND VAPOR.

Label Precautions:

Keep away from heat, sparks and flame.

Do not get in eyes, on skin, or on clothing.

Do not breathe vapor.

Keep container closed.

Use only with adequate ventilation.

Wash thoroughly after handling.

Physical and health hazard information is available from employer and from material safety data sheets.

Label First Aid:

In all cases get medical attention immediately. If swallowed and the victim is conscious, dilute, inactivate, or absorb the ingested formaldehyde by giving milk, activated charcoal, or water. Any organic material will inactivate formaldehyde. Keep affected person warm and at rest. If vomiting occurs, keep head lower than hips. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse.

Product Use:

Laboratory Reagent.

Revision Information:

MSDS Section(s) changed since last revision of document include: 4, 16.

Disclaimer:

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Prepared by: Strategic Services Division
Phone Number: (314) 539-1600 (U.S.A.)

LIQUID AIR CORPORATION
INDUSTRIAL GASES DIVISION

0071-7100

Material Safety Data Sheet

LIQUID AIR CORPORATION INDUSTRIAL GASES DIVISION One California Plaza, Suite 350 2121 N. California Blvd. Walnut Creek, California 94596	PRODUCT NAME Liquid Nitrogen	
	TELEPHONE (415) 977-6500 EMERGENCY RESPONSE INFORMATION ON PAGE 2	
	TRADE NAME AND SYNONYMS Please see last page.	CAS NUMBER 7727-37-9
	CHEMICAL NAME AND SYNONYMS Liquid Nitrogen	
ISSUE DATE OCTOBER 1, 1985 AND REVISIONS CORPORATE SAFETY DEPT.	FORMULA Liquefied N ₂	MOLECULAR WEIGHT 28.013
		CHEMICAL FAMILY Inert

HEALTH HAZARD DATA (SEE NOTE ON LAST PAGE)

TIME WEIGHTED AVERAGE EXPOSURE LIMIT Nitrogen is defined as a simple asphyxiant. Oxygen levels should be maintained at greater than 18 molar percent at normal atmospheric pressure which is equivalent to a partial pressure of 135 mm Hg (ACGIH, 1984-85).

SYMPTOMS OF EXPOSURE *

Effects of exposure to high concentrations so as to displace the oxygen in air necessary for life may include any, all or none of the following:

- o Loss of balance or dizziness;
- o Tightness in the frontal area of the forehead;
- o Tingling of the tongue, fingertips or toes;

(Continued on last page.)

TOXICOLOGICAL PROPERTIES

Nitrogen is nontoxic but the liberation of a large amount in a confined area could displace the amount of oxygen in air necessary to support life.

Frostbite effects are a change in color of the skin to gray or white possibly followed by blistering.

Listed as Carcinogen or Potential Carcinogen	National Toxicology Program	Yes ☐ No ☒	I.A.R.C. Monographs	Yes ☐ No ☒	OSHA	Yes ☐ No ☒
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RECOMMENDED FIRST AID TREATMENT

PROMPT MEDICAL ATTENTION IS MANDATORY IN ALL CASES OF OVEREXPOSURE TO NITROGEN. RESCUE PERSONNEL SHOULD BE EQUIPPED WITH SELF-CONTAINED BREATHING APPARATUS.

Inhalation: Conscious persons should be assisted to an uncontaminated area and inhale fresh air. Quick removal from the contaminated area is most important. Unconscious persons should be moved to an uncontaminated area, given mouth-to-mouth resuscitation and supplemental oxygen. Medical assistance should be sought immediately.

For dermal contact or frostbite, flush affected areas with lukewarm water. DO NOT USE HOT WATER. A physician should see the patient promptly if the cryogenic "burn" has resulted in blistering of the dermal surface or deep tissue freezing.

Judgements as to the suitability of information herein for purchaser's purposes are necessarily purchaser's responsibility. Therefore, although reasonable care has been taken in the preparation of such information, Liquid Air Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to purchaser's intended purposes or consequences of its use. Since Liquid Air Corporation has no control over the use of this product, it assumes no liability for damage or loss of product resulting from proper (or improper) use or application of the product. Data Sheets may be changed from time to time. Be sure to consult the latest edition.

HAZARDOUS MIXTURES OF OTHER LIQUIDS, SOLIDS, OR GASES

None

PHYSICAL DATA

BOILING POINT -320.445°F (-195.803°C)	LIQUID DENSITY AT BOILING POINT 50.48 lb/ft ³ (808.607 kg/m ³)
VAPOR PRESSURE @ 70°F (21.1°C) above the critical temp. of -232.51°F (-146.95°C)	GAS DENSITY AT 70°F 1 atm .07245 lb/ft ³ (1.1605 kg/m ³)
SOLUBILITY IN WATER @ 68°F (20°C) Bunsen coefficient = .01557	FREEZING POINT -346.004°F (-210.002°C)
APPEARANCE AND ODOR Clear, colorless, odorless liquid	

FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (METHOD USED) N/A	AUTO IGNITION TEMPERATURE N/A	FLAMMABLE LIMITS % BY VOLUME N/A
EXTINGUISHING MEDIA Nonflammable, inert		ELECTRICAL CLASSIFICATION Nonhazardous
SPECIAL FIRE FIGHTING PROCEDURES N/A		
UNUSUAL FIRE AND EXPLOSION HAZARDS N/A		

REACTIVITY DATA

STABILITY Unstable		CONDITIONS TO AVOID
Stable	X	
INCOMPATIBILITY (Materials to avoid) None		
HAZARDOUS DECOMPOSITION PRODUCTS None		
HAZARDOUS POLYMERIZATION May Occur		CONDITIONS TO AVOID
Will Not Occur	X	

SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED See note on last page.
WASTE DISPOSAL METHOD See note on last page.

EMERGENCY RESPONSE INFORMATION

IN CASE OF EMERGENCY INVOLVING THIS MATERIAL, CALL DAY OR NIGHT (800) 231-1366
OR CALL CHEMTREC AT (800) 424-9300

RESPIRATORY PROTECTION (Specify type) Positive pressure air line with mask or self-contained breathing apparatus should be available for emergency use.		
VENTILATION See Local Exhaust on last page.	LOCAL EXHAUST See last page. MECHANICAL (Gen.)	SPECIAL OTHER
PROTECTIVE GLOVES Loose fitting, insulated		
EYE PROTECTION Safety goggles or glasses plus face shield		
OTHER PROTECTIVE EQUIPMENT Safety shoes		

SPECIAL PRECAUTIONS*

SPECIAL LABELING INFORMATION DOT Shipping Name: Nitrogen, refrigerated liquid (cryogenic liquid) I.D. No.: UN 1977 DOT Shipping Label: Nonflammable Gas DOT Hazard Class: Nonflammable gas
SPECIAL HANDLING RECOMMENDATIONS <p>See note on last page re Spill or Leak Procedures. Also see CGA Safety Bulletin SB-2 and CGA pamphlets P-9, P-12 and P-14.</p> <p>SB-2 Oxygen Deficient Atmospheres</p> <p>P-9 The Inert Gases - Argon, Nitrogen and Helium</p> <p>P-12 Safe Handling of Cryogenic Liquids</p> <p>P-14 Accident Prevention in Oxygen-Rich and Oxygen-Deficient Atmospheres</p> <p>For additional handling recommendations consult L'Air Liquide's Encyclopedia de Gaz or Compressed Gas Association Pamphlet P-1.</p>
SPECIAL STORAGE RECOMMENDATIONS <p>See note on last page re Spill or Leak Procedures. Also see CGA Safety Bulletin SB-2 and CGA pamphlets P-9, P-12 and P-14.</p> <p>Do not store cylinders in sub-surface or closed (poorly ventilated) areas. Nitrogen gas can cause suffocation without warning.</p> <p>For additional storage recommendations consult L'Air Liquide's Encyclopedia de Gaz or Compressed Gas Association Pamphlet P-1.</p>
SPECIAL PACKAGING RECOMMENDATIONS <p>Liquid nitrogen cannot be handled in carbon or low alloy steels. Eighteen-eight and 18-10 stainless steels are acceptable as are copper and its alloys, nickel and its alloys, brass, bronze, silicon alloys, Monel[®], Inconel[®], and beryllium. Also see CGA Safety Bulletin SB-2 and CGA pamphlets P-9 and P-12.</p>
OTHER RECOMMENDATIONS OR PRECAUTIONS <p>Liquefied gas cylinders should not be refilled except by qualified producers of these products. Shipment of a compressed gas container which has not been filled by the owner or with his (written) consent is a violation of Federal Law (49CFR).</p>

*Various Government agencies (i.e., Department of Transportation, Occupational Safety and Health Administration, Food and Drug Administration and others) may have specific regulations concerning the transportation, handling, storage or use of this product which may not be contained herein. The customer or user of this product should be familiar with these regulations.

ADDITIONAL DATA

TRADE NAME AND SYNONYMS: (Continued)

Liquid Nitrogen; LIN; Nitrogen, refrigerated liquid (cryogenic liquid)

HEALTH HAZARD DATA: (Continued)

Note: Except where specified, the health hazard data and most of the other data in this material safety data sheet are for gaseous nitrogen. One volume of liquid nitrogen at its boiling point and atmospheric pressure will vaporize into approximately 695 volumes of gaseous nitrogen at 70°F (21.1°C) and 1 atmosphere.

SYMPTOMS OF EXPOSURE: (Continued)

- o Weakened speech leading to the inability to utter sounds;
- o Rapid reduction in the ability to perform movements;
- o Reduced consciousness of the surroundings;
- o Loss of tactile sensations;
- o Heightened mental activity.

It should be recognized that it is possible that none of the above symptoms may occur in nitrogen asphyxia so that there are no definite warning symptoms.

Contact with the cryogenic liquid or cold piping containing the liquid can cause tissue freezing or frostbite on dermal contact or if splashed into the eyes.

* For additional information, refer to L'Air Liquide's Encyclopedie des Gaz.

NOTE re SPILL OR LEAK PROCEDURES:

Liquid nitrogen is delivered to a customer into stationary vacuum-jacketed vessels at the customer's location or in portable vacuum-jacketed "liquid" cylinders.

Stationary customer-site vessels should be operated in accordance with the manufacturer's and Liquid Air Corporation's instructions. Do not attempt to repair, adjust, or in any other way modify the operation of these vessels. If there is a malfunction or other type of operational problem with the vessel, contact the closest Liquid Air Corporation location immediately.

Liquid nitrogen cylinders should be used only in well-ventilated areas and in accordance with the manufacturer's and Liquid Air Corporation's instructions. These cylinders must always be kept in an upright position. Specialized hand trucks are needed for their movement. A "first in-first out" inventory system should be used with these cylinders.

LOCAL EXHAUST: (Continued)

To prevent accumulation of high concentrations so as to reduce the oxygen level in the air to less than 18 molar percent.

Appendix C

HEALTH AND SAFETY PLAN ACCEPTANCE AND TRAINING ACKNOWLEDGEMENT

Instructions: This form is to be completed by each person that works on the NABIR Field Research Center work sites and returned to the Site Safety and Health Officer.

I have read and agree to abide by the contents of the SITE-SPECIFIC HEALTH AND SAFETY PLAN for work activities at the NABIR Field Research Center. I have completed the training requirements specified in the plan. I am currently participating in a medical surveillance program that satisfies the requirements of CFR 1910.120.

Signature:

Date:

Return to:

FRC Site Safety and Health Officer or
FRC Field Manager at FRC Field Site
Trailer in Y-12 Bear Creek Valley or
ORNL Building 1505, Room 302
P.O. Box 2008 MS 6038
Oak Ridge, TN 37831-6038