SHIPBOARD LABORATORY SAFETY POLICY

INTERNATIONAL OCEAN DISCOVERY PROGRAM

SEPTEMBER 2021

Prepared by the JRSO JOIDES Resolution Science Operator

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Introduction

Scope

This document is applicable to scientific operations (Laboratory and Geophysical data collection activities) aboard the R/V *JOIDES Resolution* and does not address logging, drilling, or other vessel operations.

Intent

This document is intended to

- Provide guidance to JRSO shipboard staff in interpretation and compliance with Texas A&M University (TAMU) and Siem Offshore safety documents as applicable to scientific ocean drilling operations of the *JOIDES Resolution*.
- Provide detailed safety guidance for operations not covered in any of the TAMU and Siem Offshore safety documents.
- Supplement the *JOIDES Resolution*'s Safety Management Program as mandated by SOLAS adoption of the ISM Code in 1994.

Maintenance of this Manual

This manual will be reviewed biennially (every 2 years), updated by the Supervisor of Technical Support (as needed), approved by management, and republished. The policies stated in this manual will supersede all other polices as of its publication date.

The official version of this document will be made accessible from the policy webpage. Controlled versions and revision announcements will be published and communicated to all relevant parties for implementation. Copies or extracts of this document that have been downloaded are uncontrolled copies and cannot be guaranteed to be the latest version.

Definitions

JRSO: *JOIDES Resolution* Science Operator

TAMU: Texas A&M University

ODL: Overseas Drilling Limited

EHS: Texas A&M University Environmental, Health, and Safety Department

HSE: Health, safety, and environment

Safety Management Bridging Document

Statements of Fact

- It is recognized that the *JOIDES Resolution* operates in various locations around the world and that in addition to international regulations it must comply with the applicable regulations of local jurisdictions.
- It is recognized that TAMU has a responsibility to its employees and guests to provide a safe workplace, protect the environment, and comply with the applicable regulations of the State of Texas (which operates the program) and United States Government (which funds the operation).
- It is recognized that Siem Offshore has a responsibility to its employees and guests to provide a safe workplace, protect the environment, and comply with applicable regulations that govern vessel operation.

- It is recognized that policies and regulations of the above entities may be in conflict, may not be applicable to the activity, or may fail to cover unique situations encountered while conducting scientific exploration at sea.

This document may set requirements supplemental to applicable law. However, nothing herein is intended to replace, amend, supersede, or otherwise depart from any applicable law relating to the subject matter of this document. In the event of conflict or contradiction between the provisions of this document and applicable law as to the implementation and governance of this document, the provisions of applicable law shall prevail.

Assumptions

For the purposes of this document, the following is assumed:

- Compliance with TAMU safety polices implies that we meet or exceed all applicable State of Texas and US Federal safety requirements.
- Siem Offshore's safety polices meet or exceed all applicable international, vessel's flag state, and insurance underwriter safety requirements.

EHS Management Interface

In general, the TAMU Environment Health and Safety (EHS) Department provides the primary safety control systems for scientific operations aboard the *JOIDES Resolution,* **provided that they are equal to or better than** the Siem Offshore HSE requirements and the HSE requirements mandated by local and international law where the vessel is operating.

TAMU and Siem Offshore Safety Programs/Policy Document List

- TAMU Laboratory Safety information: ***https://ehs.tamu.edu/programs/laboratory-safety/***
- TAMU Laboratory Safety Manual: ***https://ehs.tamu.edu/media/1434848/LaboratorySafetyManual.pdf***
- TAMU Safety Manual: ***https://ehs.tamu.edu/media/1601610/safety-manual-2017.pdf***
- Texas Hazard Communication Program: ***http://www.statutes.legis.state.tx.us/Docs/HS/htm/HS.502.htm***
- Other TAMU Safety Programs and Policies: ***https://ehs.tamu.edu/programs/***
  - Tier II Chemical Inventory Reporting (***https://ehs.tamu.edu/programs/chemical-inventory-program/***)
  - General, Electrical, Confined Space, and Shop Safety (***https://ehs.tamu.edu/programs/general-and-occupational-safety/)***
  - Hazardous Materials Transportation (***https://ehs.tamu.edu/programs/hazardous-material-shipping/***)
  - Siem Offshore Safety Programs/Policies (contact ship operator HSEQ at ***siemoffshore@seimoffshore.com*** or ***https://www.siemoffshore.com/***)

TAMU EHS: Hazard Communication Program

Original Document Introduction

The Texas Hazard Communication Act (THCA), Revised 1993, Chapter 502 of the Health and Safety Code (HSC), requires public employers to provide information to employees regarding hazardous chemicals they may be exposed to in the workplace. The Public Employer Community Right-to-Know Act, Chapter 506 of the Health and Safety Code, and Texas Administrative Code (TAC), Title 25 Chapter 295, requires public employers to make information regarding hazardous chemicals accessible to local fire departments, local emergency planning committees, and, through the Texas Department of Health, the general public.

The TAMU Hazard Communication (HazCom) Program is administered through TAMU Environmental Health and Safety (EHS) with responsibility for compliance delegated throughout administrative channels to every supervisor. The TAMU Hazard Communication Program applies to all TAMU and TAMUS employees at the Main Campus (College Station), Rellis Campus (Bryan), and other designated University facilities. Student employees that have occupational exposure to hazardous chemicals are covered by this program.

TAMU, through the TAMU HazCom Program, will comply with the THCA by providing training, appropriate personal protective equipment, and information regarding hazardous chemicals. In addition, written plans that describe how the TAMU HazCom Program will be implemented and will be maintained within each workplace.

Link to Texas HazCom document: ***http://www.statutes.legis.state.tx.us/Docs/HS/htm/HS.502.htm***

JRSO Policy Interpretation

For the purpose of implementation on the *JOIDES Resolution*, the terms "workspace and workplace" refer to all areas that are under the supervision of JRSO. All other areas onboard the *JOIDES Resolution* fall under the HSE policies of Siem Offshore.

Duties and Responsibilities

JRSO Director of Science Services is the "Unit Head" and has overall responsibility for the implementation and compliance of the TAMU HazCom Program and will provide the Director of TAMU EHS with the name, campus address, email address, and phone number of the staff member responsible for HazCom coordination and compliance within JRSO.

JRSO Supervisor of Human Resources is responsible for

- Reporting incidents that require medical treatment to the Director of TAMU EHS.
- Maintaining safety training records for sailing staff.
- Monitoring training status and notifying staff as necessary.
- Providing employee safety notices.
- Retaining names and telephone numbers of emergency contacts.

JRSO Manager of Technical and Analytical Services (TAS) is responsible for coordination and compliance of the HazCom Program onboard the *JOIDES Resolution.* The procedure describing the method of implementation of the TAMU HazCom Program within JRSO unit can be found in ***ATTACHMENT 1: Hazard Communication Program: Workplace Implementation Plan***.

JRSO Supervisor of Technical Support is responsible for

- Arranging annual TAMU EHS training.
- Retaining an onboard chemical inventory (electronic).

JRSO Laboratory Officer (LO) has final responsibility for day-to-day implementation of the HazCom Program and laboratory safety issues on board the *JOIDES Resolution,* which include the following:

- Posting employee safety notices and emergency contact numbers (shipboard phones).
- Giving a presentation describing the JRSO safety polices (including HazCom) to both visiting science party and new staff at the beginning of each expedition.
- Conducting a safety tour of the vessel to introduce the science party and new staff to the onboard safety systems, how to identify hazards in their work area, how to contact emergency responders, and how to get medical attention, at the beginning of each expedition.
- Informing employees and science party of any non-routine chemical exposure.
- *The LO has the initial authority to stop any laboratory activity that does not meet the safety requirements set forth in TAMU and JRSO safety policies and by instruction from the ship's Captain. Such activities should not be restarted without the direct approval of the LO.*

JRSO Operations Superintendent and Expedition Project Manager (EPM) are responsible for supporting the Laboratory Officer in enforcing safety guidelines in the laboratory spaces.

JRSO marine technical staff members are responsible for upholding safety guidelines in the laboratory spaces and ensuring the science party's actions follow the safety standards outlined in policy and procedure.

JRSO Policy Modifications

JRSO Hazardous Communication/Workplace Implementation Plan: ***ATTACHMENT 1: Hazard Communication Program: Workplace Implementation Plan***.

Safety Data Sheets (SDS): SDS are available through a number of manufacturers' websites (e.g., Sigma-Aldrich, J.T. Baker) and distributors' websites (e.g., Fisher Scientific, VWR). In addition, SDS on USB drive on the ALO PC are available in the Technical Support Office on the ship. For assistance contact the LO or Assistant Lab Officer (ALO), ship telephone extension 209.

Work Area Chemical Inventory: The LOs, through their staff, maintain an inventory list of hazardous materials for each designated storage area. In addition, a full inventory with current stock levels can be generated on demand from the Asset Management System (AMS), and the list of chemicals commonly carried aboard ship can be found on the ship laboratory overview page on both the shore and ship web pages.

Secondary labeling: See ***ATTACHMENT 5: JRSO Lab Signage and Labeling Policy.***

TAMU EHS: Laboratory Safety Manual

Original Document Introduction

It is the policy of TAMU to provide and maintain a safe environment for its faculty, staff, students, and visitors. The Laboratory and Chemical Safety Group, a component of EHS, is committed to working with faculty and staff to ensure that campus laboratories are a safe place in which to work and learn. With more than 3,000 laboratories on the TAMU campus, laboratory safety is an enormous aspect of overall campus safety. It is the responsibility of all who work or study in laboratories to do so in a safe and environmentally responsible manner.

EHS has established a Laboratory Safety Manual as a resource for faculty and laboratory personnel, as well as anyone interested in laboratory safety. This manual is intended to comply with federal, state, and local regulations, as well as industry best practices. The Laboratory Safety Manual is a compilation of suggested work practices, protocols, and procedures to work safely in TAMU laboratories. The document is not exhaustive and should not be considered the only reference for health and safety concerns. In addition to this manual, TAMU Environmental Health and Safety is available at **https://ehs.tamu.edu** to address health and safety concerns.

Link to document: ***https://ehs.tamu.edu/media/1434848/LaboratorySafetyManual.pdf***

JRSO Policy Modifications

Emergency Contact Phone Numbers: See ***ATTACHMENT 2: Emergency Contact Numbers*****.**

Laboratory Safety Inspection

- TAMU EHS Laboratory Safety Group conducts on-demand inspections of the laboratory spaces on board the *JOIDES Resolution*.
- At the beginning of each expedition the Lab Officer conducts a pre-expedition safety audit using the form in ***ATTACHMENT 3: Pre-Expedition Laboratory Inspection*****.**

Laboratory Safety Training

- **Employees**: Full compliance as stated in the TAMU EHS requirements is required of all JRSO shipboard employees.

- **Guests and New Employees:** On their first day onboard the *JOIDES Resolution* (or as soon as is practicable), all guests and new employees must attend the Siem Offshore safety introduction and the JRSO lab safety presentation and safety tour. In addition, guests will receive more specific safety information regarding specific labs.
- **All Scientists**: All guests that will be working in shipboard laboratories must certify that they have received the appropriate training for the lab procedures and the safe handling of hazardous materials in their area of research by signing the form in ***ATTACHMENT 4: Certification of Laboratory Training*.**

Hood Certification and Safe Operations: As part of the Laboratory Safety Inspection by TAMU EHS, the ventilation hoods are tested and the results provided to JRSO. It is the responsibility of the shipboard LO to ensure that the hoods are working correctly with the assistance of ship's staff. Hoods not operating correctly are tagged out and secured from use by the LO (or by the Siem Offshore Chief Engineer) until repairs are made and the hood is functioning correctly. As part of the Pre-Cruise Safety Inspection (***ATTACHMENT 3: Pre-Expedition Laboratory Inspection***) the LO inspects and signs off that the hood is operating correctly. In addition, the LO is responsible for notifying the Supervisor of Technical Support of any issues with the hoods.

Laboratory Construction and Renovation: As the laboratory space aboard the *JOIDES Resolution* is the property of Siem Offshore, construction and renovation must be approved by Siem Offshore, who is responsible for ensuring that the space and equipment comply with SOLAS requirements. Although TAMU EHS should be consulted on any issue that may affect the safety of staff, the ultimate responsibility lies with the ship owner.

Laboratories and Food: Food and drinks are forbidden in the following laboratories because of the presence of hazardous materials: Chemistry/Microbiology, Microbiology Cold Lab, Microbiology Radiation Van, and Paleontology Preparation Lab. In all other labs, the hazards present are similar to general office space; therefore, food and drinks are allowed subject to the LO's approval. Should the status change, the LO is responsible for notifying staff and posting signs.

Laboratory Security: The *JOIDES Resolution* is fully compliant with the U.S. Coast Guard Maritime Security Regulations (MARSEC). Under these regulations, access to the ship (and thus laboratories) is fully controlled at all times. This regulation exceeds TAMU laboratory security requirements. There is no uncontrolled public access to the shipboard laboratories.

Electrical and Mechanical Safety: In regard to fixed mechanical systems and electrical infrastructure, safety compliance is the responsibility of Siem Offshore (Chief Engineer and Electrical Supervisor). All other aspects of mechanical and electrical safety of laboratory equipment (and operation) are the responsibility of the Lab Officer. If there is reason to believe that any engineering control (e.g., fume hood, biosafety cabinet, glove box, local exhaust) or alarm is not functioning properly, contact the LO (dial 209) or the Engine Control Room (ECR dial 290) immediately.

Onboard Hazardous Waste Disposal:

- Ship's acid drainage system: **ONLY** non-concentrated (dilute) acids may be disposed in sinks located in the Paleontology Preparation (Aft Hood sink), Chemistry/Microbiology, Cold, and Sample Prep Labs. These sinks are connected to a Teflon-lined pipe system and acid neutralization tank. *DO NOT DISPOSE OF ANYTHING IN THESE SINKS OTHER THAN AQUEOUS SOLUTIONS OF THE APPROPRIATE TYPE. NO SOLVENTS OF ANY KIND SHOULD EVER BE POURED DOWN THESE SINKS!*
- Storage containers are provided for all other types of effluent and solid waste. A list of the type of waste and estimated quantity must be given to the LO prior to port call. The LO works with the Marine Logistics Coordinator to ensure that the waste is packaged and labeled according to the laws and regulations of the port of call or for shipment to College Station for TAMU EHS disposal.

Prior Approval for Non-Routine Analysis: Prior to engaging in a laboratory task that is non-routine and involves the following risks, participants and employees must obtain prior approval to proceed from the LO or designate:

- It is likely that toxic concentrations could be reached or other hazardous situations could arise.
- The failure of a safety system could result in a fire or the release of hazardous chemical(s) into the environment.

- There is a failure of any of the equipment used in the process, especially of safeguards such as fume hoods or clamped apparatus.

As a general guideline, any modification of a standard method that more than doubles the amount of any reagent should be discussed with the LO before continuing.

Laboratory Safety Signage and Container Labeling: See ***ATTACHMENT 5: JRSO Lab Signage and Labeling Policy***.

Use and Storage of Hydrofluoric Acid: See ***ATTACHMENT 9: JRSO Policy: Safe Use of Hydrofluoric Acid***.

Chemical Safety Controls: These controls apply to both chemicals purchased and compounds made onboard the *JOIDES Resolution*.

- **Approved Chemicals:** JRSO maintains a list of chemicals approved for use on the website (***http://JRSO.tamu.edu/labs/ship/chemicals.html***). Please note that some chemicals are routinely stocked and others by request only.
- **Chemical Segregation and Storage:** See ***ATTACHMENT 6: JRSO Chemical Segregation and Storage Policy***.
- **Request for Use of Non-approved Chemicals**: Any researcher wishing to use chemicals not listed must contact their EPM and receive approval prior to the expedition. The LO and/or ALO works with the EPM to coordinate all intended chemical use on the ship and works with JRSO Logistics staff to ensure proper handling, shipping, and storage of all hazardous materials. The Manager of TAS has the final authority to grant permission for the use of non-standard chemicals.

  The following information must be assembled for any non-standard hazardous material before approval for its use will be granted:

  - What are the required pieces of personal protective equipment (PPE)?
  - What are the appropriate spill control and clean-up procedures?
  - Does JRSO already stock the appropriate spill control materials?
  - What special training is needed to handle the hazardous material?
  - Does the JOIDES Resolution's doctor stock the appropriate medical supplies to treat exposure injuries?
  - Does the ship's doctor have the appropriate training to treat exposure injuries?
  - What are the shipping restrictions?
  - What are the storage restrictions?
  - What are the stability issues, if any, of the chemical (e.g., does it form explosive byproducts on long term storage)?
  - What hazardous waste will be generated by the use of the chemical?
  - What procedures are required for safe handling of the wastes generated by the use of this chemical?
  - Do we have the ship owner's permission to have the chemical onboard? Note: all chemicals must be registered with the Captain.
- **Chemicals Banned**: Chemicals listed in ***ATTACHMENT 7: Chemical Exclusion List*** are not approved for use on board the *JOIDES Resolution*. Employees or guests are prohibited from boarding the ship with these chemicals in their possession or from creating the chemicals onboard. Researchers can request an exemption from the Manager of TAS. Requests must be made 2 months in advance of the expedition with the EPM.

Working with the GRA ^{137}Cs Source: See ***ATTACHMENT 8: Handling the GRA 137Cs Source***.

Use and Storage of Hydrofluoric Acid: See ***ATTACHMENT 9: JRSO Policy: Safe Use of Hydrofluoric Acid.***

Other TAMU and Siem Offshore Policies and Programs

TAMU Safety Policies

TAMU safety programs not listed here are either not applicable to our situation or are fully complied with.

Hazardous Materials Transport Policy: JRSO Policy Modification

- This policy is applicable to JRSO operations once hazardous materials have been returned to TAMU. Generally, hazardous waste generated aboard ship are disposed of at port of call, and therefore are subject to local laws.
- All staff members who handle hazardous waste or are charged with creating shipping documents must have the appropriate training as required by TAMU.

Tier II Chemical Inventory Policy: JRSO Policy Modification

No Change: JRSO operations are exempt as a research laboratory; however, we do maintain an inventory of all chemicals used on board which can be found on the ship's laboratory overview page.

Siem Offshore Safety Policies

Siem Offshore safety policies are available onboard the ship through the Laboratory Officer or Siem Offshore Installation Manager.

Fall Protection: JRSO Policy Modification

- All JRSO employees (and guests) will comply with the Siem Offshore Work Aloft and Outboard and Prevention of Slips, Trips, and Falls policies.
- Siem Offshore fall protection equipment and drop safe tools are used when required. Siem Offshore maintains all fall protection equipment and drop safe tools.
- JRSO employees (or guests) that require the use of fall protection equipment must have pre-approval from the LO or Siem Offshore Installation Manager before beginning work.

Hot Work Permit: JRSO Policy Modification

- JRSO employees and their guests will comply with the Siem Permit to Work System.
- JRSO employees (or guests) that require a Hot Work permit must have pre-approval from the LO or Siem Offshore Installation Manager before beginning work.

Lockout/Tag-Out: JRSO Policy Modification

- JRSO employees and their guests will comply with the Siem Offshore Isolation of Equipment policy.
- JRSO employees (or guests) that require a Lockout/Tagout permit must have pre-approval from the LO or Siem Offshore Installation Manager before beginning work.

Confined Space: JRSO Policy Modification

- JRSO employees and their guests will comply with the Siem Offshore Confined Space Entry policy.
- JRSO employees (or guests) that require a Confined Space Work permit must have pre-approval from the LO or Siem Offshore Installation Manager before beginning work.

Shop Safety Program: JRSO Policy Modification

Not applicable to situation because JRSO does not have a designated shop within a controlled space. However, all personnel given permission to use power equipment must demonstrate to the LO that they understand the proper use of the equipment, potential hazards, and proper use of PPE. The ship has a full library of shop safety video for individual training.

ATTACHMENT 1: Hazard Communication Program - Workplace Implementation Plan

Name of Unit: International Ocean Discovery Program – JR Science Operator (JRSO)

Positions responsible for assuring compliance with training requirements:

- Shore Staff
  - JRSO Director of Science Services (Unit Head)
  - JRSO Manager of Technical and Analytical Services
  - JRSO Supervisor of Technical Support
- Shipboard Staff
  - JRSO Laboratory Officer
  - JRSO Staff Scientist/Expedition Project Manager
  - JRSO Operations Superintendent

Location of Employee Training Records:

- Primary Copy: Supervisor of Human Resources, 1000 Discovery Drive, College Station TX 77845, USA
- Shipboard Copy: Technical Support Office, *JOIDES Resolution*

  Signed paper documents, like those for the Shipboard Laboratory Safety Tour, group HF Safety Training, Radiation Safety Surveys, Pre-Expedition laboratory Inspection, and others, will be scanned by the shipboard Publication Specialist and sent to the Supervisor of Technical Services and stored in the Publications Archive in the shore-based digital asset management system.

Location of Material Safety Data Sheets: USB drive on ALO PC in the Technical Support Office aboard the *JOIDES Resolution.*

Location(s) where the "NOTICE TO EMPLOYEES" is permanently posted: Onboard the *JOIDES Resolution*; Fo'c'sle Deck hallway just outside the Chemistry Lab.

Responsibility for compiling the annual Workplace Chemical Inventory: Research Lab exempt: To comply with international maritime requirements, JRSO maintains a chemical list for each storage area which is linked from the ship's laboratory pages, and a list with onboard stock level can be generated by the Asset Management System (AMS) upon request.

Location where the Workplace Chemical Inventory Records are filed: Research Lab exempt: The storage lists are available from the Lab Officer.

ATTACHMENT 2: Emergency Contact Numbers

Shipboard Contacts

Contact	Extension
Hospital	**255**
Doctor's stateroom	**254**
Bridge	**200**
Engine control room	**290**
LO/ALO office	**209**
Maintenance office	**279**
24/7 HF exposure assistance	**9-800-498-5701**

For 24/7 HF Exposure Assistance: 9-800-498-5701*

Contact Ship's Doctor First upon HF Exposure!

Shore Contacts

Contact	Phone*
TAMU EHS	**9-979-845-2132**
JRSO Assistant Director of Science Services	**9-979-845-5740**
JRSO Manager of Technical and Analytical Services	**9-979-845-5740**
JRSO Supervisor of Technical Support	**9-979-845-5716**
JRSO Supervisor of Analytical Systems	**9-979-845-2520**
JRSO Human Resources Supervisor	**9-979-862-3482**
TAMU Ethics Point**	**9-888-501-3850**

**May be made from any phone with off-ship access. No phone card required.*

** Anonymous tip line may be called to report risk (generally unsafe conditions) or misconduct (waste of campus resources, fraud, etc.) on campus.

ATTACHMENT 3: Pre-Expedition Laboratory Inspection

A copy of the completed and signed inspection form must be stored aboard ship and a digital copy sent to the JRSO Supervisor of Technical Support, who is responsible for storing the forms on the "North" server in the "IODP_SHARE/TASTech/Shipboard Safety Training Documents" folder.

BRIDGE DECK

- ☐ Safety shower functionality test (outside of hazardous lockers)

Flammable Storage

- ☐ Eye Wash Station Functional Test
- ☐ Eye Wash Station—Solution Expiration Checked
- ☐ Materials Secured
- ☐ Chemical Inventory/Inspection Completed: BFLAM
- ☐ Ventilation Fan Operational

Chemical Storage

- ☐ Eye Wash Station Functional Test
- ☐ Eye Wash Station—Solution Expiration Checked
- ☐ Materials Secured
- ☐ Chemical Inventory/Inspection Completed: BHAZ
- ☐ Ventilation Fan Operational

CORE DECK

Paleo-Prep Lab

- ☐ Eye Wash Station Functional Test
- ☐ Safety Shower Functional Test
- ☐ Chemical Inventory/Inspection Completed: CPAL-12
- ☐ Chemical Inventory/Inspection Completed: CPAL-13
- ☐ Chemical Inventory/Inspection Completed: CPAL-14
- ☐ Chemical Inventory/Inspection Completed: CPAL-15
- ☐ Chemical Inventory/Inspection Completed: CPAL-16
- ☐ Fume Hoods Inspection Completed: C7
- ☐ Fume Hoods Inspection Completed: C8
- ☐ Spill Control Materials Available

Core Receiving Platform

- ☐ Eye Wash Station—Solution Expiration Checked
- ☐ Chemical Inventory/Inspection Completed: CTWK

Core Splitting Room

- ☐ Chemical Inventory/Inspection Completed: CSPLIT
- ☐ Ventilation Fan Operational
- ☐ Gas Cylinders Properly Secured

Core Entry-track Area

- ☐ Radioactive Inventory Completed: CRAD
- ☐ Spill Control Materials Available

Downhole Lab

- ☐ Eye Wash Station—Solution Expiration Checked

FO'C'SLE and POOP DECKS

Chemistry Lab

- ☐ Eye Wash Station Functional Test
- ☐ Safety Shower Functional Test
- ☐ Chemical Inventory/Inspection Completed: BC1
- ☐ Chemical Inventory/Inspection Completed: BC2
- ☐ Chemical Inventory/Inspection Completed: F3
- ☐ Chemical Inventory/Inspection Completed: F4
- ☐ Chemical Inventory/Inspection Completed: G-C1
- ☐ Chemical Inventory/Inspection Completed: G-C2
- ☐ Chemical Inventory/Inspection Completed: M-F1
- ☐ Chemical Inventory/Inspection Completed: M-F2
- ☐ Fume Hoods Inspection Completed: F1
- ☐ Fume Hoods Inspection Completed: F2
- ☐ Fume Hoods Inspection Completed: F3
- ☐ Fume Hoods Inspection Completed: F4
- ☐ Spill Control Materials Available

Chemical Spill Locker

- ☐ Spill Control Materials—Expiration Checked

X-Ray Lab

- ☐ Chemical Inventory/Inspection Completed: FXL

Thin Section Lab

- ☐ Eye Wash Station Functional Test
- ☐ Eye Wash Station—Solution Expiration Checked
- ☐ Chemical Inventory/Inspection Completed: FTSL

Microbiology Rad Van

- ☐ Eye Wash Station—Solution Expiration Checked
- ☐ Chemical Inventory/Inspection Completed: FBRAD

Underway Lab

- ☐ Eye Wash Station—Solution Expiration Checked

'TWEEN DECKS

Staging Area/Shop

- ☐ Eye Wash Station—Solution Expiration Checked

Pallet Storage

- ☐ Gas Bottles Secured

EXPEDITION:	
DATE:	
LAB OFFICER'S NAME:	
LAB OFFICER'S SIGNATURE:	

ATTACHMENT 4: Certification of Laboratory Training

Texas A&M University's policy governing hazardous materials requires that JRSO ensure that all employees and members of the science party working in the laboratories aboard *JOIDES Resolution* have received proper training before working with or in an area containing hazardous chemicals and maintain a record of the training. Members of the science party must have received training specific for the procedures and chemical used in their study (in addition to the safety instructions provided by the staff).

Visiting scientists, observers, and consultants can sign a statement (below) that they have already received equivalent training from their institution or employer.

My signature below confirms that I have received the necessary laboratory training, and that I am familiar with the procedures for safe handling of hazardous materials used in my research aboard the *JOIDES Resolution*.

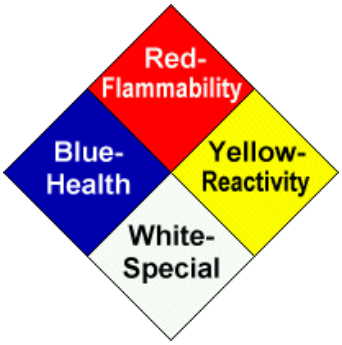
Signature:_____ Date:_____

ATTACHMENT 5: JRSO Lab Signage and Labeling Policy

JRSO uses the National Fire Protection Association (NFPA) 704 hazard chemical identification system onboard the *JOIDES Resolution*. This system is readily recognized and easily understood for identifying specific hazards and their severity for staff, visitors, and especially for emergency responders who may be non-English speakers. This policy applies only to space under JRSO control and supplements safety signage posted by the ship's owner.

Quick Introduction to the NFPA system

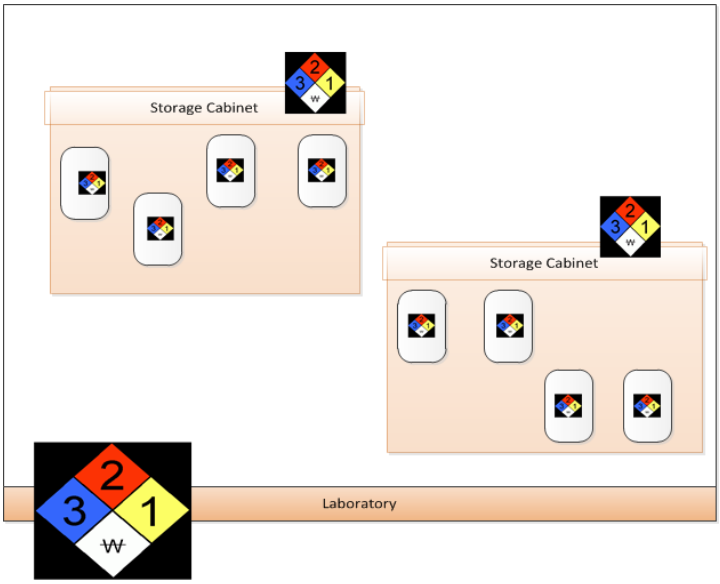
The NFPA standard uses spatial, visual, and numerical methods to describe the relative hazards of a material. It addresses the health, flammability, instability, and related hazards that may be presented as short-term, acute exposures that are most likely to occur as a result of fire, spill, or similar emergency.



The system is characterized by the diamond shape. Hazard severity is indicated by a numerical rating that ranges from zero (0) indicating minimal hazard, to four (4) indicating severe hazard. The hazards are arranged spatially as follows: health at the left (9 o'clock) position, flammability at the top (12 o'clock) position, and stability at the right (3 o'clock) position. In addition to the spatial orientation that can be used to distinguish the hazards, they are also color-coded as follows: blue for health, red for flammability, and yellow for instability.

The bottom (6 o'clock) position on the symbol represents special hazards and has a white background. The most common special hazards in use are W, which indicates unusual reactivity with water and is a caution about the use of water in either firefighting or spill control response, and OX, which indicates that the material is an oxidizer. Other common symbols include ALK (alkaline), ACID (acidic), COR (corrosive), and ☢ (radioactive).

Signage and Labeling



Onboard the *JOIDES Resolution*, the NFPA 704 system provides three levels of hazard communication. The following outlines the locations for signage, how to determine the ratings, and who is responsible for maintaining the signage.

LEVEL 1: JRSO Laboratories, Shops, and Storage Areas

Mounting: The NFPA 704 Placard is posted at each principal means of entry into a space that contains hazardous materials to provide quick hazard information for emergency responders; it should be visible in case of emergency where the responders are likely to enter. If there are numerous areas where the responders could enter, there should be numerous placards. The NFPA 704 Placard is used in addition to the ship's owner safety signage.

Values: The numeric value marked in each hazard category is the maximum value for all chemicals and gases stored in the space.

Responsibility: The Lab Officer ensures that spaces storing hazardous materials have the correct NFPA signage.

LEVEL 2: Storage Cabinets

Mounting: The NFPA 704 Placard is mounted on the door of all chemical storage areas or on the wall above mounted gas bottles.

Values: The value marked in each hazard category is the maximum values for all chemicals stored in a cabinet or for the group of mounted gas bottles.

Responsibility: Technical staff in charge of the space make sure that all storage cabinets and gas bottles have the correct NFPA label.

LEVEL 3: Original Containers

Labeling: All chemicals/gases unpacked onboard the *JOIDES Resolution* **must be inspected for damage and an NFPA label must be applied** (if not provided by the vendor).

Some vendors use the Hazardous Material Identification System (HMIS, pictured right) instead of NFPA (see HIMS section, below). At first glance, the HMIS and NFPA labeling systems appear quite similar. Both have four sections colored blue, red, yellow, and white. HMIS uses colored bars, while NFPA uses colored diamonds. If an HMIS label is already present, there is no need to attach an NFPA label as well. Apply the NFPA in such a way as NOT to cover the original labeling.

Values: Hazard rating information for various chemicals can be obtained from their MSDS.

Responsibility: The Assistant Lab Officer ensures that all chemicals brought onboard have an NFPA label.

LEVEL 3: Secondary Containers

Often materials are moved from the original containers into smaller containers (secondary) for ease of use. Secondary containers also apply to containers for chemical compounds generated onboard. Because of our status as a research lab, secondary container labeling is not required under Texas Hazard Communication Act (THCA). However, JRSO policy requires that **all secondary containers be labeled with the chemical's name (as in the MSDS), concentration, initials of who prepared it, the date of preparation, and an NFPA label for containers with volumes greater than 250 mL.**

Labeling requirements do not apply to portable container(s) intended for the immediate (within a work shift) use by the individual who performs the transfer. However, the contents should be readily identifiable and if the container is preserved for next shift, must be labeled prior to shift change.

Other Safety Signage

Maritime Safety: All other safety signage required by maritime law is provided by the ship's owner.

TAMU Safety: All other safety signage and labeling complies with TAMU policy.

Guide to the NFPA 704 Hazard Label

The full NFPA 704 document (PDF) is available onboard the *JOIDES Resolution*. See the LO or ALO for the server location. Also, explanatory signage has been posted on all decks.

Health hazard

4 – very short exposure could cause death or serious residual injury even though prompt medical attention was given.

3 – short exposure could cause serious temporary or residual injury even though prompt medical attention was given.

2 – intense or continued exposure could cause temporary incapacitation or possible residual injury unless prompt medical attention is given.

1 – exposure could cause irritation but only minor residual injury even if no treatment is given.

0 – exposure under fire conditions would offer no hazard beyond that of ordinary combustible materials.

Flammability hazard

4 – material will rapidly or completely vaporize at normal pressure and temperature, or is readily dispersed in air and will burn readily.

3 – liquids and solids that can be ignited under almost all ambient conditions.

2 – must be moderately heated or exposed to relatively high temperature before ignition can occur.

1 – must be preheated before ignition can occur.

0 – materials that will not burn.

Reactivity hazard

4 – readily capable of detonation or of explosive decomposition or reaction at normal temperatures and pressures.

3 – capable of detonation or explosive reaction, but requires a strong initiating source or must be heated under confinement before initiation, or reacts explosively with water.

2 – normally unstable and readily undergoes violent decomposition but does not detonate. Also, may react violently with water or may form potentially explosive mixtures with water.

1 – normally stable, but can become unstable at elevated temperatures and pressures or may react with water with some release of energy, but not violently.

0 – normally stable, even under fire exposure conditions, and are not reactive with water.

Special hazard

This section is used to denote special hazards. One of the most common is unusual reactivity with water. The letter W with a horizontal line through it as shown indicates a potential hazard using water to fight a fire involving this material.

Other symbols, abbreviations, or words may appear here to indicate unusual hazards. Some examples include the following (not all of which are necessarily part of the NFPA system):

OX – Oxidizer, a chemical that can greatly increase the rate of combustion or fire.

ACID – Acid, a corrosive material that has a pH lower than 7.0.

ALK – Alkaline, also called a base. These caustic materials have a pH greater than 7.0.

COR – Corrosive (it could be either an acid or a base).

~~W~~ – Not compatible with water (keep dry).

Another symbol used for corrosive.

Poison or highly toxic material or marine pollutant.

Radioactive hazard. Radioactive materials are extremely hazardous when inhaled and/or ingested.

Explosive material (somewhat redundant because explosives are easily recognized by Reactivity Rating).

Toxic to aquatic life.

Hazardous Material Identification System (HMIS)

The HMIS classification system is similar to the NFPA but is divided into three hazard categories and a personal protection category. These are defined as follows:

Blue (Health)

0 – No significant risk to health.

1 – Irritation or minor reversible injury possible.

2 – Temporary or minor injury may occur.

3 – Major injury likely unless prompt action is taken and medical treatment is given.

4 – Life-threatening, major, or permanent damage may result from single or repeated overexposures.

Red (Flammability)

0 – Materials that will not burn.

1 – Materials that must be preheated before ignition could occur. Includes liquids, solids, and semi-solids having a flash point > 200°F (93°C).

2 – Materials that must be moderately heated or exposed to high ambient temperatures before ignition will occur. Includes liquids having a flash point at or >100°F (38°C) but <200°F (93°C).

3 – Materials capable of ignition under almost all temperature conditions. Includes flammable liquids with flash points <73°F (23°C) and boiling points >100°F (38°C), as well as liquids with flash points between 73°F (23°C) and 100°F (38°C).

4 – Flammable gases, or very volatile flammable liquids with flash points <73°F (23°C) and boiling points <100°F (38°C). Materials may ignite spontaneously with air.

Yellow/Orange (Physical Hazard)

0 – Materials that are normally stable, even under fire conditions, and will not react with water, polymerize, decompose, condense, or self-react. Also non-explosives.

1 – Materials that are normally stable but can become unstable (self-react) at high temperatures and pressures. Materials may react non-violently with water or undergo hazardous polymerization in the absence of inhibitors.

2 – Materials that are unstable and may undergo violent chemical changes at normal temperature and pressure with low risk for explosion. Materials may react violently with water or form peroxides upon exposure to air.

3 – Materials that may form explosive mixtures with water and are capable of detonation or explosive reaction in the presence of a strong initiating source. Materials may polymerize, decompose, self-react, or undergo other chemical change at normal temperature and pressure with moderate risk of explosion.

4 – Materials that are readily capable of explosive water reaction, detonation or explosive decomposition, polymerization, or self-reaction at normal temperature and pressure.

White (Personal Protection)

Required personal protective equipment will be listed here. Typically this is by word, but may also use a letter code as shown in the figure below.

HMIS® Letter	Required Equipment				
A	Safety Glasses				
B	Safety Glasses	Gloves			
C	Safety Glasses	Gloves	Protective Apron		
D	Face Shield	Gloves	Protective Apron		
E	Safety Glasses	Gloves	Dust Respirator		
F	Safety Glasses	Gloves	Protective Apron	Dust Respirator	
G	Safety Glasses	Gloves	Vapor Respirator		
H	Splash Goggles	Gloves	Protective Apron	Vapor Respirator	
I	Safety Glasses	Gloves	Dust Respirator	Vapor Respirator	
J	Splash Goggles	Gloves	Protective Apron	Dust Respirator	Vapor Respirator
K	Air Line Mask or Hood	Gloves	Full Suit	Boots	
L thru Z	Site-specific label. Ask your supervisor or safety specialist for handling instructions				

ATTACHMENT 6: JRSO Chemical Segregation and Storage Policy

All chemicals used aboard the *JOIDES Resolution* will be stored as follows:

- Storage will comply with TAMU's chemical segregation guidelines.
- Storage will be in approved, designated locations.
- Each storage area will be marked with the appropriate NFPA sign (***ATTACHMENT 5: JRSO Lab Signage and Labeling Policy***).
- Each storage location will have a list of allowable chemicals.
- It is the responsibility of the designated technician to confirm that the chemicals inside the storage area:
  - Are on the approved list
  - Are properly labeled
  - Have current expiration dates
  - Have fully sealed containers

Chemical inspection will be completed at the beginning of each expedition (part of ***ATTACHMENT 3: Pre-Expedition Laboratory Inspection***). Any chemical not on the list must be removed and placed in the correct storage area or given to the Chemistry technician for disposal.

ATTACHMENT 7: Chemical Exclusion List

The following chemicals should not be allowed aboard the ship unless they are carefully considered and an exception approved by JRSO management. All chemicals in a family on this list must be tracked carefully (if allowed on board) and disposed of promptly (except for teratogens, which includes many common reagents).

Explosives: all chemicals that are labeled as explosive should not be brought aboard the ship without written approval. Pyrophoric compounds, such as finely divided powdered metals, are not technically explosive but should be treated as such.

Peroxide formers: materials that react with oxygen to form unstable organic peroxy chemical groups (-O-O-). Such materials are highly reactive and are often shock sensitive. Chemicals in this classification fall into two groups for disposal purposes:

- Dispose at 3 months: isopropyl ether, divinyl acetylene, vinylidene chloride, butadiene, chloroprene, tetrafluoroethylene
- Dispose at 12 months: diethyl ether, tetrahydrofuran (THF), dioxane, acetal, vinyl ethers, diacetylene, methyl acetylene, cumene, cyclohexene

Recommended JRSO policy for peroxide-forming chemicals is not to allow them except with special permission, and at the conclusion of the expedition to which they were shipped, for them to be disposed of properly. White or blue crystals can form (peroxide salts) that are shock sensitive. If crystals are apparent around the lid, do not open the container and dispose of immediately.

Picric acid: this is normally supplied wetted (~10% water). When dry, the material becomes shock sensitive, so picric acid containers should be examined monthly and deionized water added if needed. If crystals are apparent around the lid, do not open the container and dispose of immediately. Picric acid should not be kept on board beyond the expedition where it was used.

Perchloric acid (and perchlorates in general): these should not be used aboard ship if at all possible because a spill can create inorganic or organic perchlorates that are shock sensitive. Magnesium perchlorate, used in the CHNS analyzer as a water trap, should be handled and disposed of properly; all other perchlorates should be avoided.

Peroxy compounds: examples include benzoyl peroxide and peracetic acid; they become unstable when their solvent evaporates and should be disposed of within 6 months of being opened.

Group I and II metals: examples include lithium, sodium, magnesium—the free metal should always be kept under oil (to prevent reaction with moisture in the air) and the quantity kept to a very small amount, then disposed of when the material is no longer needed.

Extreme toxicity or carcinogenicity: some chemicals (e.g., methyl mercury) are so extremely toxic or carcinogenic that they should not be allowed without special handling procedures in addition to special permission. Any chemical labeled as highly toxic or carcinogenic should be carefully considered before approval is granted.

Teratogens: some compounds (e.g., benzene, acetonitrile, sodium nitrite) are teratogenic and pose a significant risk to human fetuses; should any member of the shipboard staff or science party become pregnant while on board, they should notify the ship's doctor immediately so that exposure to teratogens can be minimized.

ATTACHMENT 8: Handling the GRA ^{137}Cs Source

- The gamma ray attenuation (GRA) source is part of the Whole-Round Multisensor Logger (WRMSL) and Special Task Multisensor Logger (STMSL) in the core lab and is fixed to the supporting benches. It contains a ^{137}Cs sealed source with a nominal activity of 10 millicuries (mCi). This activity is high enough to be a short-term hazard if humans are exposed to the beam directly. The source continually emits gamma radiation and is only rendered 100% safe when the aperture is in the closed position (see below).
- The source is housed in lead shielding inside a chromed steel container.
- The source housing has an internal plug/collimator (with two positions) and a selector arm.
- The internal plug-type source housing has no removable plug, and a selector arm to open and close the collimator aperture.
    - In the closed position, the lead blocks the gamma rays being emitted from the source. The selector arm should be in the closed position when shipping the source or when working on other instruments close to the source. When shipping, the selector arm shall be padlocked or zip-tied in place so it cannot open.
    - In the open position, a beam of gamma rays is emitted that penetrates the target and then enters the detector. Whenever the selector arm is in the open position, the source must be pointed at the detector, which is shielded to prevent the gamma rays from passing through and into the lab. In addition, the hand shield, which connects to the source and detector housing, must be installed to prevent hands from slipping into the beam.
    - The source has two open positions, a 1/16-inch aperture (lever against the stop) and a 1/8-inch aperture (lever fully locked on stop); we used the larger aperture setting so be sure the source is set properly for good counting times and statistics for the GRA measurement.
- The sealed ^{137}Cs source must **NEVER** be removed from the housing for **ANY** reason by staff. When it is time to replace the source, the ENTIRE housing is shipped to the vendor and returned to the ship as a unit.
- While onboard the ship the source housing is always secured in its mount or in its sealed shipping crate.

ATTACHMENT 9: JRSO Policy on Safe Use of Hydrofluoric Acid

Purpose and Scope

This policy establishes safe work procedures for personnel working with hydrofluoric acid (HF). It outlines safe work practices to prevent injury to users and to avoid early termination of the expedition for medical evacuation.

This policy covers all uses of HF onboard the *JOIDES Resolution* by JRSO staff or visiting scientists or any activity within spaces under JRSO supervision.

Introduction

Hydrofluoric acid is a clear and colorless corrosive liquid. HF is also available as gaseous material. All forms of HF can cause severe burns to tissues, which makes its handling and use especially hazardous. HF easily dissolves glass and can attack enamel, pottery, concrete, rubber, leather, many metals, and organic compounds. Upon reaction with certain metals, explosive hydrogen gas may form.

HF, though a weak acid, is physiologically a very potent chemical due to fluoride ions, which can bind with calcium and magnesium ions in tissue. Concentrated HF, liquid or vapor, may cause severe burns, electrolyte imbalance, pulmonary edema, and/or life-threatening cardiac arrhythmias. Even moderate exposure may rapidly progress to fatality if not treated promptly and properly. Symptoms of exposure may be delayed for several hours; therefore, immediate medical intervention, even in the absence of symptoms, is necessary.

HF is sold in three major forms: anhydrous HF gas, "fuming" concentrations of aqueous HF solution (>40%), and "non-fuming" concentrations (≤40%). The *JOIDES Resolution* does not have proper safety controls for gaseous or fuming HF, so JRSO only permits the use of non-fuming concentrations. Therefore, the maximum allowable concentration of HF is 40%; care must be taken to ensure that only 40% or lower concentrations are purchased or allowed on board.

Approvals to use HF

The JRSO Manager of Technical and Analytical Services must be notified no later than 4 months prior to the beginning of an expedition that HF will be used. Expedition investigators using HF must indicate the amount needed and provide a written procedure for their process. This information will be reviewed to determine if it is in compliance with this policy.

Once approved, the JRSO Supervisor for Technical Support will order the HF and ensure all of the following are available on the ship:

- Appropriate PPE
- Spill control materials (**2×** the amount to neutralize HF onboard)
- Hazardous waste containers (**4×** the volume of HF onboard)
- Medical supplies for mitigating HF exposure. (See ***Medical Supplies*** below)

Use of HF will not be allowed without sufficient quantities of all the supplies listed above.

Medical Supplies

Treatment	Ingredients	Size	Quantity
Skin treatment	2.5% calcium glucometer gel	25 g tubes	8 each
Eyewash	Calcium gluconate USP 1%, benzalalkonium, sodium chloride (saline), sodium borate, and boric acid in isotonic, buffered, sterile solution	120 mL bottle	12 each
Injectable solution	10% calcium gluconate	10 mL ampoules	8 each
Inhaler	Beclometason diproprionate	80 mcg	10 each

Medical Response

See companion document from Honeywell in ***Appendix 9A: Honeywell HF Medical Brochure.***

Shipping

- Direct shipments of HF from the vendor to the *JOIDES Resolution* should be avoided if possible.
- The JRSO Marine Logistics Coordinator/IODP Materials Technician must inspect all received HF. If the shipment is vendor direct or local port call purchase, inspection responsibility transfers to the Laboratory Officer. **THIS RESPONSIBILITY CANNOT BE DELEGATED to anyone other than the JRSO Marine Logistics Coordinator/IODP Materials Technician or the Laboratory Officer!** Inspection must include but not be limited to the following:
    - HF should be in 500 mL or smaller bottles.
    - HF concentrations must not exceed 40%, i.e., non-fuming strength.
    - Each bottle must be individually sealed in plastic bags.
    - Total quantities of HF available per expedition will be limited to 10 liters.
    - Packaging and documentation must comply with applicable federal and international shipping regulations.
- If sent by sea container, the HF must be protected from damage from other loose items in the container.
- In port, it is the responsibility of the JRSO Marine Logistics Coordinator to work with the local port agent and authorities to ensure that HF is handled safely. HF spills in port will be handled by the local authorities.
- Note that silicon-based packing material such as vermiculite will react with spilled HF and can form SiF_6 fumes. If the packaging is damaged and a leak has spread into the packing material, the box may produce dangerous fumes. For this reason, only HF-rated spill kits should be used to clean up HF spills.
- Per TAMU Health and Safety Plan, chapter XIX. Hazardous Materials Transportation:

The University is also committed to comply with all applicable regulatory requirements imposed by the US Department of Transportation (DOT) and the International Air Transport Association (IATA) as penalties and fines for errors, even minor errors are severe. Shipments of hazardous materials may only be made by persons who have completed approved training and have been certified as HazMat shippers.

In Addition: Anyone who loads, unloads, or handles hazardous materials or prepares hazmat packages and/or shipping papers for transport by carriers, must have completed Hazardous Material training (See section 4.0 of the TAMU Health & Savety Plan, Section XIX, for training description).

Shipboard Handling and Storage

- Prior to moving HF onto the ship, the LO or ALO must inspect packaging for possible leaks.
- Loading onboard:
    - Only individuals who have completed Hazardous Materials training may handle the packaged HF.
    - The crew handling the crane and rigging must be made aware that this is a hazardous lift.
- Prior to unpacking, the LO or ALO must ensure the following:
    - Staff handling the HF have the proper Hazard Material training
    - Staff are wearing the appropriate PPE
    - Spill control material is available
- When unpacking, each bottle MUST be inspected for leaks prior to storing. There should be no liquid inside the plastic bag, and the packing material must be dry.
- When unpacking, there must be at least two personnel present in full PPE protection: one unpacks and the other stands by to assist with spills and prevent other staff from coming into the area until the HF is secured.
- Never store incompatible materials in the designated HF storage cabinets.
- The HF storage cabinets must remain locked at all times.

WARNING! THE GREATEST CHANCE OF AN HF INCIDENT IS DURING TRANSPORT AND HANDLING.

HF Work Restrictions

- Only persons who have read and understood this document and who are suitably trained will be allowed to use HF.
- General training of safe HF usage should be provided to all lab staff and scientists for the expedition. Specific training of safe HF usage, including video, should be provided to IODP technical staff and scientists who will be working in the Chemistry, X-ray, and Thin Section labs, and scientists who will directly handle HF for the expedition.
- Lab personnel will work using the buddy system; No one is allowed to work alone. Specifically in the Chemistry Lab, there must be at least one other staff member who is aware that HF work is in progress and they may not leave the Chemistry Lab until the HF work has been completed and containers of HF secured.
- HF will not be used when the ship's motion limits normal safe handling of chemicals. Prior to any usage of HF on each expedition, the LO should establish a routine protocol with the Bridge to determine safe handling regarding ship motion and weather/sea conditions.
- Only the HF-rated hoods may be used for HF work. One HF-rated hood is in the chemistry lab and one is in the paleontology preparation lab. It is preferred that HF work be done in the chemistry lab so the work can be properly supervised.
- The HF hood and safety shower must have passed the Lab Officer's Pre-Expedition inspections.

Designating and Preparing the HF Work Area and Hood

- The LO and/or ALO will consult with the doctor and captain each time HF is used to ensure that they know when HF use will begin and when it has been completed.
- Warning signs must be mounted on the chemical hood notifying the user that HF is in use.
- Mark off an area around the hood sufficient for the planned work, including solid waste disposal (plastic trash can), as the designated HF work area. Remove or cover with plastic sheeting any supplies or equipment not used in the HF procedures.

- Mark the work area's boundary using safety tape and signage.
- Post the safety reference poster "Treatment of Hydrofluoric Acid (HF) Exposure Quick Reference" (from Honeywell's HF_medical_book.pdf) in the work area.
- Once HF work has begun until the final clean-up and decontamination, all personnel must wear appropriate PPE in the work area.
- Provide a solid waste plastic trash can for disposable gloves, wipes, empty HF bottles (triple rinsed and sealed), etc. Trash must be doubled bagged.
- Inside the hood, set up a liquid waste carboy (polyethylene) already filled 1/3 with water and pre-charged with an acid neutralizer for liquid waste.

Required HF Handling Practices

- Food and drink are never allowed where HF is handled or stored.
- Remove all jewelry before entering the HF work area.
- HF may only be used inside a properly working HF-rated chemical fume hood. Before using, always check that the fume hood is working properly.
- Procedures involving even small quantities of dilute HF solutions must not be performed outside of a hood.
- Only one bottle of concentrated HF may be in use at a time and must kept in the hood at all times.
- Keep HF containers closed as much as possible. Never leave the work area with opened HF inside a hood.
- Prevent contamination of the work surfaces inside the hood by placing plastic trays or bench paper on the work surface before starting HF procedures.
- Work in a fume hood with the sash closed as much as possible.
- Do not wear safety boots outside the designated HF work area or street shoes inside to prevent the possibility of tracking HF outside the work area.

Minimum Personal Protective Equipment (PPE) Requirements

Wear appropriate work clothing under PPE (long-sleeved shirt, long pants, and closed shoes). Do not wear shorts and sandals in laboratory!

GLOVES

- Neoprene, nitrile, or butyl rubber composition gloves with minimum thickness of 20 mil—at least 12 inches long to cover the wrist and provide arm splash protection. A nitrile exam glove should be worn under the outer glove. Single disposable nitrile gloves alone will NOT provide adequate protection!
- Leak checking of gloves is required. This can be accomplished by blowing the gloves up with air and submerging them in water. Leaking gloves should be discarded immediately!

BODY PROTECTION

- A neoprene (polyvinyl chloride [PVC], Lexan (polycarbonate resin), or polyvinylidene fluoride [PVDF]) smock with sleeves that seal around the gloves.
- Worn over the smock, a full neoprene apron that covers the front of the body and overlaps safety boots.

EYE PROTETCTION: Goggles (PVC, Lexan, or PVDF) that fully protect the eyes, along with a full-face shield (PVC, Lexan, or PVDF) to protect the face.

FOOTWEAR: Neoprene safety boots. A location is provided to change into the boots and leave street shoes.

Note: Any safety gear directly exposed to HF should be replaced. Don't reuse gloves that have been immersed in a solution containing HF.

Waste Disposal

Solids

- A solid waste plastic trash can must be located next to the hood and double bagged with a 3-mil thick plastic liner.
- Move materials from the hood to the trash can inside a plastic tray to avoid any drips.
- Empty HF containers (or sample containers that held HF) must be triple-rinsed before placing inside the trash can.
- When removing solid waste from the trash can, first tie shut the doubled-bagged waste and then slip it into another 3-mil trash liner. Tie shut and label as HF waste. Store the triple-bagged waste in a secure location until disposal in port.

Liquids

Fluoride Test Strips:

1. If sufficient neutralization agent is used (meaning an excess of the neutralizer), it should not be necessary to test the solution for free F^- ions, but if this is desired to confirm the ions are neutralized, fluoride test strips can be used for this purpose.
2. The variety of fluoride test strips currently used on the ship require the pH of the solution to be <1 to properly indicate free fluoride ions. Always test the pH of a waste solution before swabbing with a fluoride test strip. If the pH is >1, place several drops of waste solution in an appropriate container and add several drops of 5%–10% HCl, test that the pH is <1; if so, test the waste with the fluoride test strip.

   Note: Strong mixtures of HCl can cause bleaching of the fluoride test strips. The test strips are not accurate for solutions <20 ppm; consult the manufacturer instructions for additional information.
3. The fluoride strips are usually stored in the Laboratory Officer's office.

Acid Eater Procedure:

Whenever possible, use the Acid Eater procedure to dispose of liquid HF waste. Commercial "Acid Eater" HF neutralizer solution is capable of neutralizing free F^- ions at a 1:1 waste:solution volume at up to 50% HF concentration (w/v). Because the JRSO does not allow the use of HF solutions of greater than 40% strength, it can be assumed that the "Acid Eater" ties up 100% of the HF so long as equal volumes are used.

1. Use a polyethylene funnel and polyethylene carboy. Do NOT use glass!
2. Place a carboy in the HF hood and fill 1/3 with Acid Eater. Label the container "HF Waste" and mark the 2/3 fill line; this ensures that the user cannot exceed the HF neutralization capability of the material and leaves room for pH neutralization if needed.
3. If HF only is being neutralized, the Acid Eater should indicate neutral range pH and the supernatant liquid waste can be simply dumped down the sink. Remember that using 1:1 Acid Eater:HF will always neutralize the F^- ions, so the waste is no longer "HF waste" but just general lab waste (that might still be acidic).
4. If the HF waste includes strong acid (e.g., 10% HCl was added to samples), it will need to be pH neutralized even though the fluoride ions have been bound (see below).

   Note: If fluoride test strips are going to be used, do it now, before you neutralize the pH, because the strips require pH ~1 to work.
5. Acid Eater solution does not have the buffer capacity to handle strong acids (e.g., HCl, HNO_3), which are commonly used in the palynology procedures. In this case, the waste will still indicate low pH (red color) even though the F^- ions have been captured. It is still necessary to follow our acid disposal guidelines to dispose of this waste even after the fluoride ion danger has been dealt with.
6. Fluoride-neutralized waste needs to be in the range of pH 5–9 to be considered non-hazardous aqueous waste that can be disposed of by pouring down the drain. (**Take care to decant away from any solids**, as they may clog the drain, although these solids are non-hazardous and can be placed in the trash.)

Note: Leave sufficient volume in the carboy for acid neutralization to take place to avoid the need to transfer the waste to other containers.

7. If Acid Eater is not available, use the Calcium Salt HF Neutralization Procedure, below.

Calcium Salt HF Neutralization Procedure:

1. Use a polyethylene funnel and polyethylene carboy. Do NOT use glass!
2. Place a carboy in the HF hood filled 1/3 with water, and pre-charge with a fluoride ion scavenging salt (e.g., $CaCl_2$, $CaCO_3$, or CaO) sufficient to neutralize an equal volume of 40% HF (see table below).
3. Label the container "HF WASTE" and mark the 2/3 fill line. Do not exceed this volume so that sufficient room is available to adjust the pH before disposal (if needed).
4. When 2/3 full, test the container using fluoride ion test strips, adding additional calcium salt solution until the fluoride is all bound. Not that when using some calcium salt solutions, it can take a significant amount of time for the salt to dissolve, extending the time necessary for HF neutralization.

   Note: The HF–Ca salt reaction is exothermic. Take appropriate precautions.
5. Once the fluoride ions are neutralized, test the pH of the solution. Some calcium salts, CaOH, for example, is highly basic and may have raised the solution pH above 9. Use acid (HCl) or base to neutralize to a range of pH 5–9 before disposing as non-hazardous liquid.
6. In all cases, slowly add HF waste to the container. Do not add more than 500 mL at a time. Repeat this process to neutralize more than 500 mL.

General Notes

1. Neutralizing HF with Acid Eater or a calcium salt forms CaF_2 (fluorite/fluorospar, which is non-toxic), producing a fine powder with 0.004% solubility in water. This powder cannot be poured down the drain, as the low solubility could cause the drain to clog. The CaF_2 solids remaining after pouring the neutralized supernatant down the drain are not hazardous; however, enough neutralizing agent to ensure 100% binding of fluoride ions must be used. Use the following table to determine how much neutralizing agent is needed.

Neutralizing agent	Amount to neutralize 100% HF	Nontoxic reaction product	Amount to neutralize 500 mL of 40% HF	Note
Acid Eater			500 mL	Use equal volumes of up to 40% HF and Acid Eater
$CaCO_3$	2.69 lb/lb	CaF_2	620 g	
$CaCl_2$	2.98 lb/lb	CaF_2	690 g	
CaO	1.46 lb/lb	CaF_2	340 g	
$Ca(OH)_2$	2.01 lb/lb	CaF_2	470 g	

2. If it is not possible to neutralize the waste, wipe down the container and place it inside a 3-mil plastic trash bag. Remove the carboy from the lab and place it inside a plastic tray (of greater volume) partially filled with absorbent material (not silica-based). Store in a secure area until port disposal.
3. Take caution not to store discarded HF for extended periods of time, as HF will embrittle all plastic materials. Polyethylene is the preferred plastic due to its unusual resistance to HF.

DO NOT DISPOSE OF ANY HF LIQUID WASTE DOWN SHIP'S DRAINS WITHOUT PROPERLY NEUTRALIZING FIRST.

Work Area and Hood Clean-up

- Wear all PPE as required by this protocol.
- Seal all unused HF bottles, re-bag, and place in storage.
- Remove all solid waste from the hood per this protocol.
- DO NOT ATTEMPT to rinse out the ductwork.
- Apply Neutrasol solution (using a sponge) to all exposed surfaces inside the hood (remove baffle panels as necessary). Wipe down the bottom edge of the sash and the threshold.
- Allow at least 5 minutes before rinsing.
- Rinse at least three times with clean water using a sponge. Test with fluorine ion test strip; remember that the test strip only works at pH~1. Take a small amount of the moisture, acidify, and test.
- Transfer rinse water to the liquid waste carboy.
- Wipe down the carboy and dispose of sponge and wipes into the solid waste.
- Wipe up lose material from the work area floor and place into the solid waste.
- Apply Neutrasol solution (using a sponge) to the floor.
- Allow at least 5 minutes before rinsing.
- Rinse at least three times with clean water using a sponge. Test with fluorine ion test strip; see note above.
- Transfer rinse water to the liquid waste carboy.
- Wipe down the carboy and dispose of sponge and wipes into the solid waste.
- Remove the liquid waste from the hood per this protocol.
- Remove the solid waste from the trash can per this protocol.
- Take plastic trash can and reusable PPE to the catwalk and thoroughly rinse before returning to service.
- The Lab Officer must verify that the hood is reasonably HF free before removing signage.

Emergency Measures to Hydrofluoric Acid Exposure

Avoid all types of exposure to HF. When working, pay close attention to the task at hand and do not become distracted. Contact with dilute HF solutions may not produce immediate pain but may result in severe burns without immediate treatment.

Skin Exposure: Rapid decontamination is critical to minimizing/preventing injury. If exposure occurs, remove contaminated clothing and immediately wash the affected area with copious amounts of water for 15 minutes. Although it is normal to wash a chemical exposure for 15 minutes, Honeywell's HF skin exposure guidance is to irrigate for a shorter time and begin calcium gluconate of benzylalkonium chloride treatment sooner. Have someone else call for medical assistance during this time. After washing affected areas, apply calcium gluconate first aid gel. Calcium gluconate binds HF and prevents it from penetrating deeper into tissues. This is critical.

Inhalation: Immediately remove victim to clean air until emergency personnel arrive on scene. Unlike external splashes, inhalation exposure is a serious medical emergency, as there are no immediate decontamination procedures. Keep person calm until medical help arrives.

Eye Exposure: Immediately flush eyes for at least 15 minutes with copious amounts of water until emergency personnel arrive on scene.

ALL HYDROFLUORIC ACID EXPOSURES ARE A MEDICAL EMERGENCY!
IMMEDIATELY CONTACT THE SHIP'S MEDICAL PERSONNEL. PHONE 255

Electrical Power Loss

Should electrical power to the hood exhaust fans be lost, immediately close all open containers of HF, close the sash, and leave the HF work area. Call the Engine Control Room (ECR) at Ext. 290 to verify that hoods are running before resuming work.

HF Spill Management

All areas where HF is used must have proper spill control kit.

IMPORTANT! It is vitally important that ONLY HF spill kits be used to counter an HF spill, as the silicates in a typical acid spill kit will form volatile silicon fluoride compounds that are highly toxic.

Any type of spill or accidental release of HF must be reported immediately to the Bridge (Ext. 200) or the Engine Control Room (Ext. 290) if the Bridge is unavailable. Inform the LO/ALO (Ext. 209) as soon as possible.

Small spills: neutralize by covering with **hydrofluoric acid neutralizer/sodium bicarbonate** and absorb with spill control pads/absorbents (see previous note). Once the spill is contained, isolate the room and leave the area immediately. When contacting the Bridge or ECR, inform them of the scale of the spill.

Large spills: immediately evacuate all persons in the area and close all doors. **Do not shut down the exhaust fans so that they can continue to draw air out of the space.**

Instructions to Bridge/Engine Control Room Upon Receiving Notice of HF Spill

Secure Personnel and the Work Area

- Shut down heating, ventilation, and air conditioning (HVAC) systems to the ship's living quarters and laboratories to prevent HF fumes from recirculating.
- DO NOT SHUT DOWN THE CHEMICAL EXHAUST SYSTEMS. Allow these fans to run, as they will remove any fumes from the space.
- Announce an HF emergency on the public address (PA) system requesting the Lab Officer and medical personnel report to the Fo'c'scle deck outside the Hospital.
- Simultaneously, the following should happen:
    - Determine the nature of the spill and if anyone is still inside the Chemistry Lab
    - Two first responders begin putting on breathing apparatus
- Search lab for any victims and remove immediately to the hospital.

It is critically important to remove any victims from the area;
Inhalation of HF fumes at worst can be fatal
and at best requires immediate evacuation and medical attention.

Once the area is secure, develop a spill mitigation plan that avoids putting anyone else at risk.

JRSO HF Safety Policy Agreement

My signature below indicates that I have read the SDS sheet for Hydrofluoric acid and JRSO's "Policy for Safe use of Hydrofluoric Acid" and agree to abide by these regulations.

Expedition:_____

Name:_____

Date:_____

Lab Officer:_____

Appendix 9A: Honeywell HF Medical Brochure