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# Contamination Tracer Delivery System: User Guide

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## Manual Information

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## Contents

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<a href="#">Manual Information</a>	<a href="#">1</a>
<a href="#">Contents</a>	<a href="#">1</a>
<a href="#">Introduction</a>	<a href="#">2</a>
<a href="#">Apparatus, Reagents, &amp; Materials</a>	<a href="#">2</a>
<a href="#">Tracer Preparation</a>	<a href="#">6</a>
<a href="#">Pump Set-up</a>	<a href="#">6</a>
<a href="#">Rigwatch Integration</a>	<a href="#">7</a>
<a href="#">Tracer Delivery Confirmation</a>	<a href="#">8</a>
<a href="#">Preparation for Storage</a>	<a href="#">8</a>
<a href="#">Health, Safety, and Environment</a>	<a href="#">8</a>
<a href="#">Troubleshooting</a>	<a href="#">109</a>
<a href="#">Technical and Reference Documents</a>	<a href="#">1140</a>

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## Contents

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<a href="#">Topics</a>	<a href="#">View page...</a>
------------------------	------------------------------

<a href="#">Introduction</a>	<a href="#">1</a>
<a href="#">Apparatus, Reagents, &amp; Materials</a>	
<a href="#">Tracer Preparation</a>	
<a href="#">Pump Set-up</a>	
<a href="#">Rigwatch Integration</a>	
<a href="#">Preparation for Storage</a>	
<a href="#">Health, Safety and Environment</a>	
<a href="#">Technical Information</a>	

## Introduction

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### Method Theory

When cores are recovered for microbiological studies, tracers can be added to the drilling fluid via the mud pump lines in order to track contamination of core material. The method was developed and implemented on Ocean Drilling Program Leg 185 and subsequently documented in ODP Tech Note 28 (Smith et al. 2000). The following manual explains the tracer fluid preparation, the pump setup as well as the monitoring with the Rigwatch System.

### Selecting the Appropriate Tracer

The original perfluorocarbon tracer ([PFT](#)) compound- chosen for the method was Perfluoro(methylcyclohexane) ([PFPMCH](#)). An additional tracer fluid was introduced on IODP expedition 360, Perfluoro(methyldecalin) (PFMD).

The science user needs to decide which tracer will be used.

## Apparatus, Reagents, & Materials

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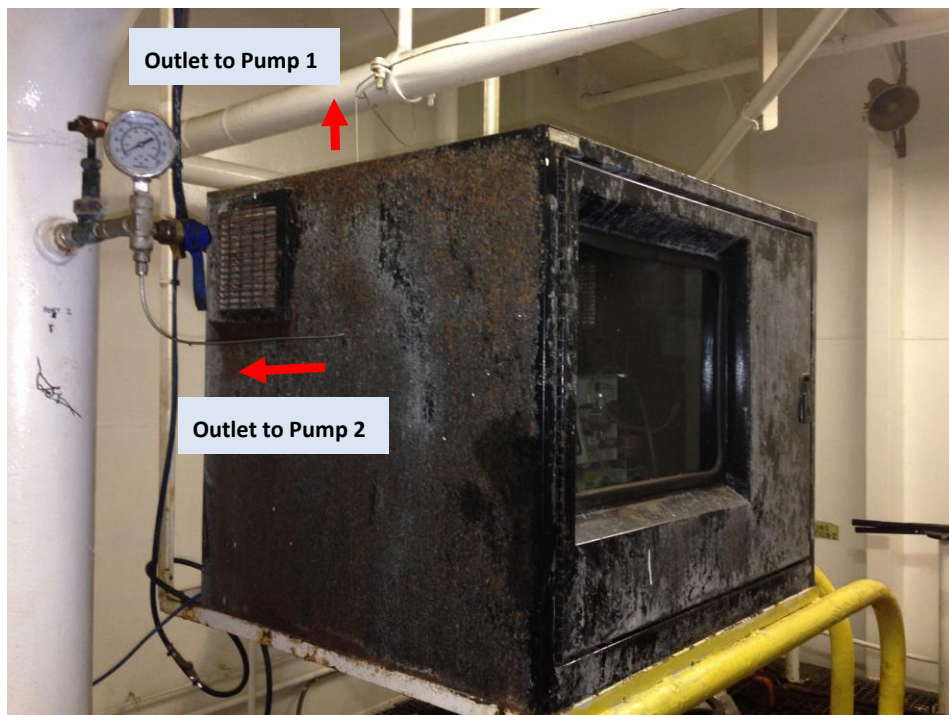
### Hardware

#### HPLC Pumps

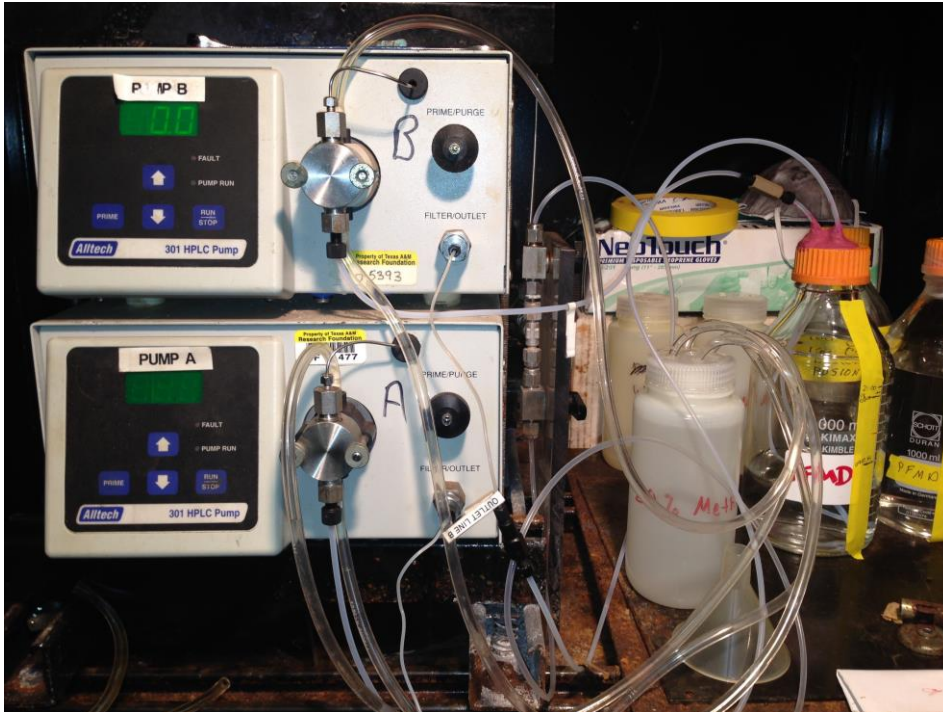
An Altech 301 HPLC pump is used to inject the tracer into the drilling fluid. There are two HPLC pumps in a housing in the Mud Pump Room. Only one pump is used at a time, the second is a back-up.

#### Tracer Pump Housing in Mud Pump Room

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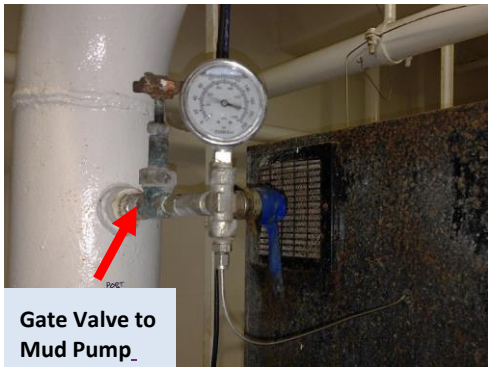


### Alltech 301\_HPLC Pumps



### Plumbing

- Plastic peristaltic tubing and clear Tygon tubing is used for plumbing the HPLC pumps.
- 1/8" stainless steel tubing lines exit the tracer pump housing and run to the inlet valves of mud pump 1 and 2. Tracer is pumped from one of the HPLC pumps into these lines. Only one mud pump is typically used for the expedition. The line to pump 1 runs up and over across the room to the gate valve.



Gate Valve to  
Mud Pump  
Fluid Stream

Inlet to Mud Pump 2  
Next to pump housing



Inlet to Mud Pump 1  
Across room from  
pump housing

### Data Connector

An Ethernet serial server is located inside the pump housing above the pumps and is used to communicate with the pumps with Rigwatch via the ship's network.

### Reagents

- Tracer – Perfluoromethylcyclohexane (PFT)
- Tracer – Perfluoromethylcyclodecalin (PFMD)
- Methanol – 20% solution
- Isopropyl Alcohol

## Materials

- Bucket – Labeled for tracer transport
- Funnel
- 1 L Glass Media Bottles as pump reservoir
- 250 mL Nalgene bottles for flush fluid and waste.
- Personal Protective Equipment (PPE)

## Tracer Preparation

Before handling the tracer, read the safety data sheet (SDS) for the tracer to be used to familiarize yourself with the hazards and safe handling of the material. The tracers are used as is and their unit of order and checkout is kilogram.

Assemble the materials needed for transport and transfer of the tracer from the stock bottles to the reservoir bottle. This includes a bucket, funnel and PPE.

Handling of the tracers and transfer of the tracer to the reservoir bottle should be done in a well ventilated area well away from the core handling area and tracer detection areas. ~~Transfer can be done inside the BHAZ area. The preferred area for tracer transfer is on the helideck.~~ If you need to make a quick transfer, go to the starboard, aft end of the roof of the lab stack where vapor will blow off the vessel as it is typically headed into the wind. Use a funnel to pour the tracer from its original bottle into a 1 liter glass media bottle. Label the bottle with the type of tracer in it and seal the bottle cap with Parafilm M®. Wear protective gloves, eyewear and an organic vapor mask when transferring the tracer. Discard your gloves after the procedure.

## Pump Set-up

Refer to the Alltech 301 pump manual for schematics and specific instruction on pump set-up and use. The term “mobile phase” used in the manual refers to the material you wish to pump, in this case it is our tracer.

Before setting up the pumps, find out from the Operations Superintendent which mud pump will be used for the expedition, 1 or 2. Prepare a 20% Methanol solution in a 250 mL Nalgene bottle, the chemistry technicians can help with this. There should be bottles in the pump housing designated for this.

The two pumps reside in a black housing on the port side of the mud pump room. This area requires hearing protection in addition to your normal PPE. When you arrive at the pumps they should be turned off and been left primed with isopropyl alcohol as instructed in the manual. The stainless steel lines to both mud pumps should be disconnected from the mud pump lines and capped. Familiarize yourself with all of the lines connected to the pumps, which lines go where and in what direction.

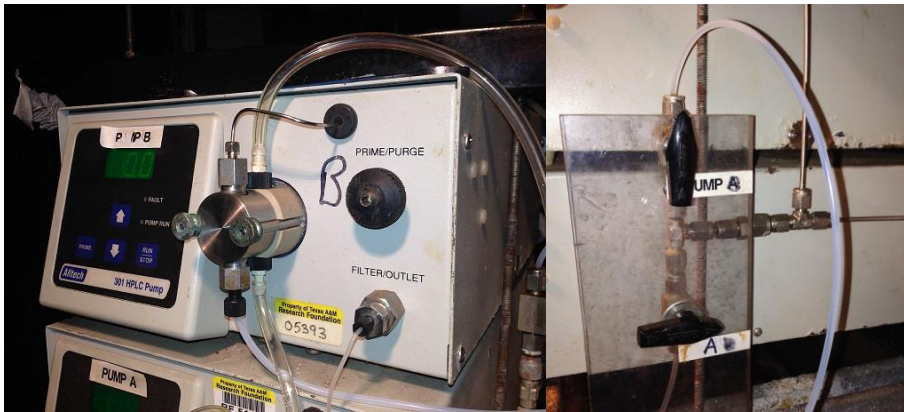
**CAUTION: Do not run the pumps until you are sure the lines are opened and valves turned the right way. Running the pumps in a closed system may burst the small plastic tubing.**

## Priming the Pumps

Decide which pump is to be used, A or B. Remove the bottle of isopropyl alcohol from the cap (with the pump intake lines inserted in it) and replace it with the bottle of tracer. Follow the instructions in the manual (section

2.4.5) to prime the pump with tracer using the syringe located in the pump housing. Waste can be placed into the waste bottle.

Remove the short clear plastic tube that is looped from the barbed fittings on top of the pump head to the bottom, this is the self-flushing head. Install the Nalgene cap with the clear plastic tubes in it to a new bottle of 20% methanol solution. Connect one of the clear plastic lines from the bottle to the bottom of the self-flushing head. Follow the instructions in the manual (section 2.4.5) for flushing the self-flushing head using the syringe located in the pump housing.



### Priming the Distribution Lines

Now that the pump is primed, open the outlet valve for that pump on the manifold that leads to the stainless steel lines. Uncap the stainless steel line at the far end that goes to the mud pump that will not be used. Switch on the power to the pump, switch on the back. Unplug the data cable on the back of the pump in order to run the pump in manual mode. Press the Run button to start pumping. Adjust the pump rate to get the liquid to flow. You want to make sure the fluid is flowing indicating there are no obstructions in the lines. Capture as much waste as you can into the waste bottle. Stop pumping and connect the stainless steel line to the mud pump line, leave the valve closed. Uncap the stainless steel line for the mud pump that will be used and follow the same procedure ensuring that fluid is flowing. Stop pumping and connect the line to the mud pump line and open the gate valve. Connect the data cable back into the back of the pump in use. Now the pump is ready for operation and can be controlled by Rigwatch.

### Rigwatch Integration

The Alltech pumps can be run through a remote connection via the ship's network. Rigwatch is used to control the pump rate to deliver the tracer at a predefined concentration. The driller will switch on and off the pump as directed by the operations plan provided by the Operations Superintendent.

When setting up the pump, the RJ-11 connector (like a phone jack) on the data cable must be plugged into the back of the pump being used. The serial connector on the other end must be plugged into the Ethernet serial server. If you encounter problems with the data connection contact IODP IT support.



Ethernet Serial Server

## Tracer Delivery Confirmation

Delivery of the tracer can be verified by taking a sample of the drilling fluid while the tracer is being injected from a special stainless steel line connected to the Stand Pipe located in the starboard, aft corner of the drill floor by the door. Open the valve and let the line flush for a while before taking the sample. The scientist running the tracer experiment can measure the sample and verify delivery.

## Preparation for Storage

When the tracer experiment is complete the pumps need to be isolated and prepared for long term storage. It is critical to flush all tracer out of the pump and lines to prevent fouling the pump and lines. Refer to section 2.5.1 of the Alltech manual for instructions on preparing the pumps for storage. Basically prime and flush the pump and lines with isopropyl alcohol. Close the gate valve to the mud pump line using and remove the stainless steel lines from the mud pump lines and follow the same instructions above to prime the pumps and lines with alcohol. Prime both pumps and lines to ensure all tracer is flushed from the system. Cap both stainless steel lines. Leave the pump inlet lines in the isopropyl alcohol reservoir. Remove the self-flushing line and replace with the short loop of tubing.

## Health, Safety, and Environment

### Health

#### Perfluorocarbon Tracers

[Perfluoromethylcyclohexane and perfluoromethyldecalin are used as the perfluorocarbon tracer compounds. These compounds \(one of which, PFMCH, is highly volatile\), is chemically inert and of extremely low toxicity. Although it is relatively harmless, PFMCH, especially, can permeate widely if not used under properly ventilated conditions and cross-contamination of environment-to-sample can occur.](#)

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Safe handling guidelines for the PFT chemical compound consist of the following:

- Perform PFT chemical dilution and standards preparation procedures under a ventilated hood.
- Avoid direct contact with PFT chemicals by wearing gloves.
- Do not leave open PFT solutions in unventilated areas.
- Make sure no vials with PFT are left in the oven during and after PFT analysis procedure.
- Wear personal protective equipment including gloves and labcoat when working with PFT.

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#### Health Hazards:

Both PFMCH and PFMD are considered to be non-hazardous by US and EU classifications under normal conditions.

#### Chemical Hazards:

- Incompatible substances: oxidizing agents, strong acids, strong bases
- Emits toxic fumes (HF) under fire conditions

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### Isopropyl Alcohol

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Isopropyl alcohol is a flammable liquid and a central nervous system depressant. Isopropyl alcohol can build up a static charge when poured in large quantities, so a grounding strap may be necessary. (This is usually not an issue with a glass bottle of 500 mL or 1 L, or when pouring small quantities.)

Safe handling guidelines for isopropyl alcohol consist of the following:

- Keep away from heat/sparks/open flames/hot surfaces. No smoking.
- Keep container tightly closed.
- Take precautionary measures against static discharge.
- Avoid breathing vapors.
- Wash skin thoroughly after handling.
- Use only outdoors, in a well-ventilated area, or under a laboratory hood.
- Wear protective gloves and eyewear.
- Store in a well-ventilated place, segregated from incompatible chemicals (e.g., oxidizers)

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#### Health Hazards:

Isopropyl alcohol is highly toxic if ingested; its fumes are considered only an irritant in properly-ventilated surroundings or with the use of a chemical fume hood.

- Causes serious eye irritation.
- May cause drowsiness or dizziness.
- In case of skin contact: Take off all contaminated clothing. Rinse skin with water/shower.
- Eye contact: Rinse out with plenty of water. Call an ophthalmologist (ship's doctor should do so). Remove contact lenses.
- Ingestion: Do **not** induce vomiting. Take caution if victim vomits (risk of aspiration)! Keep airways free. Pulmonary failure possible after aspiration of vomit. Call a physician immediately.

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#### Chemical Hazards:

- Incompatible substances: oxidizing agents, strong acids, strong bases.
- Vapors are heavier than air and may spread upon floors.

All of the tracers and chemical used in the represent a risk to health.

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Perfluoromethylcyclohexane is used as the perfluorocarbon tracer compound. This volatile compound is chemically inert and of reasonably low toxicity. Although it is relatively harmless, it can permeate widely if not used under properly ventilated conditions and cross-contamination of environment to sample can occur.

Safe handling guidelines for the PFT chemical compound consist of the following:

- ~~–Perform PFT chemical dilution and standards preparation procedures under a ventilated hood.~~
- ~~–Avoid direct contact with PFT chemicals by wearing gloves.~~
- ~~–Do not leave open PFT solutions in unventilated areas.~~

- Make sure no vials with PFT are left in the oven during and after PFT analysis procedure.
- Wear personal protective equipment including gloves and labcoat when working with PFT.

**Health Hazards:**

- Contact: irritant
- Inhalation: irritant
- Ingestion: irritant

**Chemical Hazards:**

- Incompatible substances: oxidizing agents, strong acids, strong bases
- Emits toxic fumes under fire conditions

**Safety**

**Chemical**

**PPE**

**Pollution Prevention**

All chemicals should be collected and disposed of appropriately.

**Troubleshooting**

Issue	Possible Causes	Solution
Pump does not power on	No power to the power outlets in the pump housing	Contact a ship's electrician to reestablish power to the housing
	Pump is broken	Use the other pump. Consult <a href="#">the manual</a> and an IODP ET to diagnose the problem, <a href="#">a fuse may have blown.</a>
Fluid cannot be primed (pulled) into the pump	Inlet lines from the reservoir are clogged	<a href="#">Inspect the lines and if suspect they are clogged, replace the lines and clean fittings.</a>
	Pump is clogged	<a href="#">Consult the manual for cleaning procedures.</a>
Fluid does not exit the lines	Valve closed	Open valve
	Pump clogged	<a href="#">Consult the manual for cleaning procedures.</a>
	Exit lines clogged	<a href="#">If pump is functional, the outlines may be clogged. Replace the lines.</a>
Pump does not run with Rigwatch command	Data cable not connected	<a href="#">Confirm data cable is connected to operational pump and Ethernet server</a>
	Network connection lost	<a href="#">Contact IODP IT support</a>

	Equipment malfunction	<a href="#">Troubleshoot to determine which piece of equipment is malfunctioning.</a>

## Technical and Reference Documents

The technical manuals for the components of the system are available through Cumulus at this link: <http://mckinley.ship.iodp.tamu.edu:8080/>. The user does not need to log in to Cumulus to see these documents.

These documents include:

- Alltech Model 301 Pump Operator's Manual, July 1998
- Smith, D. C., et al. 2000. Methods for quantifying potential microbial contamination during deep ocean coring. *ODP Tech Note 28*