

MBIO tracer pump User Guide

Contamination Tracer Delivery System: User Guide

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Alltech 301 HPLC Pumps

Introduction

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.



NOTE: The pump manual gives details on the HPLC pumps setup, use, and storage. If this is your first time setting up the pumps, it is highly recommended that you read through it. A link to the manual is located in the references section of this page

Selecting the Appropriate Tracer

The original perfluorocarbon tracer (PFT) compound chosen for the method was Perfluoromethylcyclohexane (PFMCH). An additional tracer fluid was introduced on IODP expedition 360, Perfluoromethyldecalin (PFMD). The science user needs to decide which tracer will be used.

Apparatus, Reagents, & Materials

Hardware

HPLC Pumps

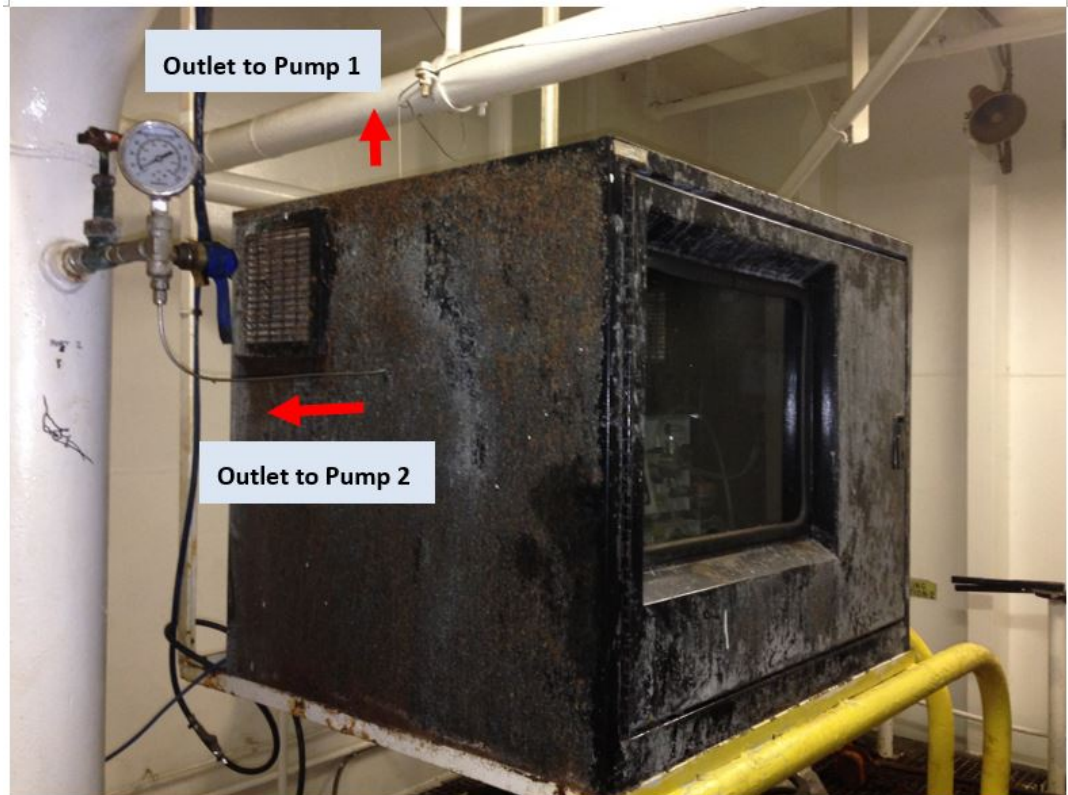
An Altech 301 HPLC pump is used to inject the tracer into the drilling fluid. There are two HPLC pumps (Pump A, Pump B) in a housing in the Mud Pump Room. Only one pump is used at a time, the second is a back-up. In the figure below



Altech 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.



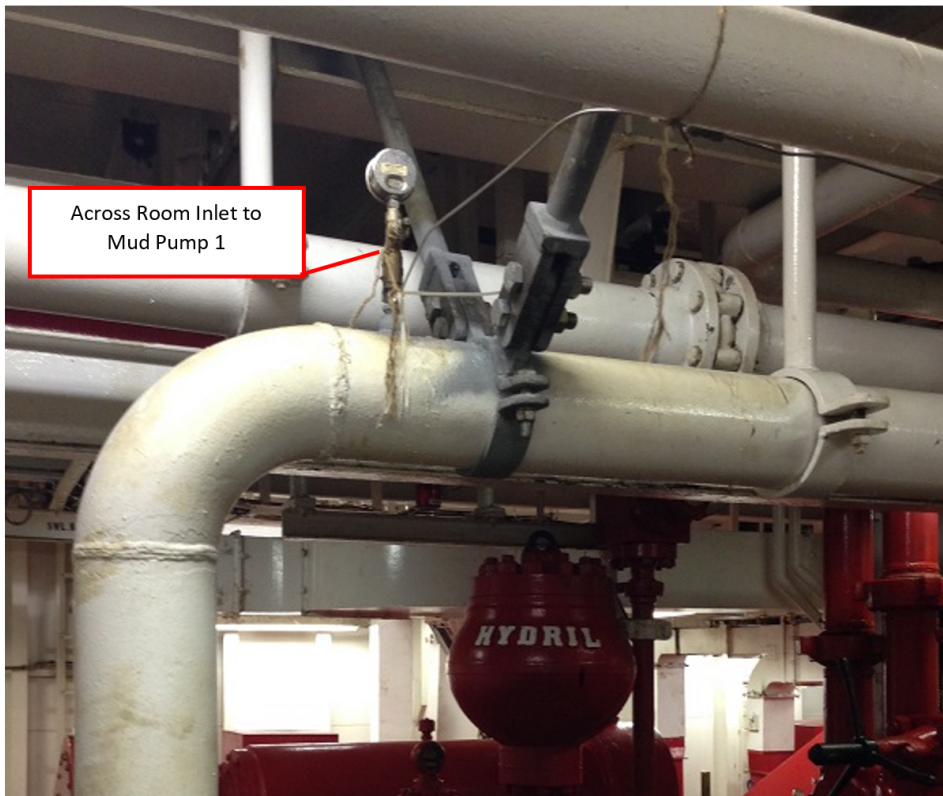
HP.

- A valve manifold switches the output to the stainless steel lines between HPLC pump A and B. Either pump will output to both stainless steel mud pump inlet lines. Its located on the right side of the HPLC pumps. The valve turned parallel to the intake lines means that line is open.

*Valve Manifold for Output from
Pump A or Pump B*

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. It connects to the HPLC pumps via a serial cable.



Reagents

- Tracer – Perfluoromethylcyclohexane (PFMCH)
- Tracer – Perfluoromethyldecalin (PFMD)
- Methanol – 20% solution
- Isopropyl Alcohol

Materials

- Bucket – Labeled for tracer transport
- Yellow Tape For Labeling
- Parafilm M®
- Metal Funnel
- (2) 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, yellow tape, a fine point sharpie, and PPE. The tape and gloves may already be in the HPLC pump housing.

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, eye-wear and an organic vapor mask when transferring the tracer. Discard your gloves after the procedure.

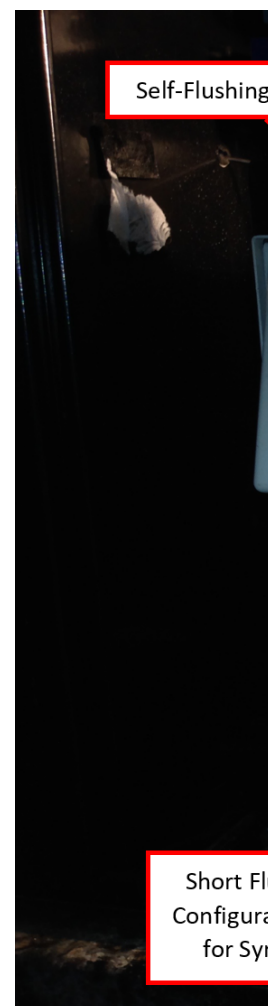
Pump Set-up

In general, the pumps require several steps at the start of an expedition.

1. Cleaning and priming the self-flushing head with a 20% methanol solution.
2. Priming the pump with the tracer.
3. Priming/Flushing the stainless steel distribution lines.



The figure below shows some of the components you will need to know.



Tracer Pump During Setup with Call Outs

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

Find out from the Operations Superintendent which mud pump will be used for the expedition, 1 or 2 (you should prepare both lines for use in case the mud pumps are changed). You can setup the pump without knowing this, but it is important to find out, and to leave the pumps in the proper configuration for drilling.

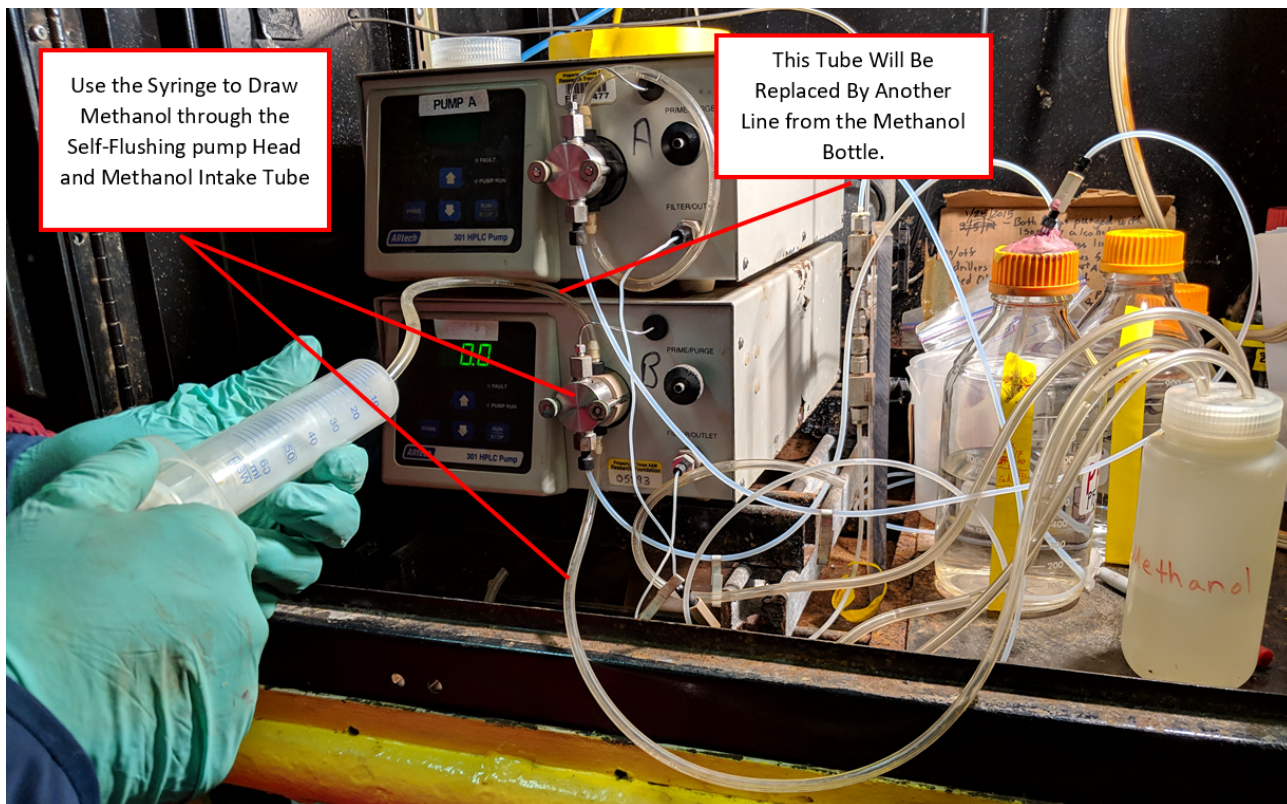
The two pumps reside in a black housing on the port side of the mud pump room. This area requires hearing protection in addition to your normal PPE. When you arrive at the pumps they should be turned off and been left primed with isopropyl alcohol as instructed in the manual. The stainless steel lines 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.

Cleaning and Priming the Self-Flushing Heads

The self flushing head requires an approximate volume 250 ml, of 20% methanol. During use the methanol is drawn and expelled into the same bottle, and reused, so only 1 bottle is needed. For this purpose there is a Nalgene bottle with 4 clear, large diameter tubes running to the 2 pump heads. Only one HPLC pump will be used at a time, and each has lines running into the same methanol bottle. The self-flushing head is an open air reservoir that surrounds part of the pump piston. Therefore, The pump will not need to be run for this step. Once primed, the self-flushing head will draw and discharge methanol from the same bottle. The bottom of the head draws methanol and the top of the head discharges it.

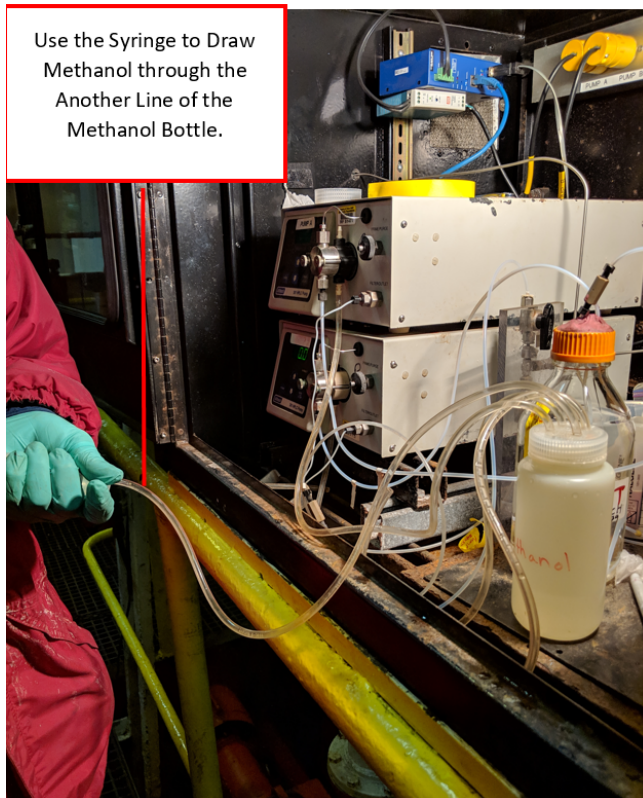
Prepare a 20% Methanol solution in a 250 mL Nalgene bottle, the chemistry technicians can help with this. There should be bottles in the pump housing designated for this.

Remove the bottom of short clear plastic tube that is looped from the barbed fittings on top of the pump head to the bottom, (this is the normal storage configuration). 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, additional notes 1.1.3) for flushing the self-flushing head using the syringe located in the pump housing. The bottle should have 4 clear plastic lines total, 2 running to and from each pump head. Some photos are included below for demonstration.



Use the Syringe to Draw Methanol through the Self-Flushing pump Head and Methanol Intake Tube

This Tube Will Be Replaced By Another Line from the Methanol Bottle.



Use the Syringe to Draw Methanol through the Another Line of the Methanol Bottle.



When the Tube Is Full, Pinch It and Connect It to the Top of The Self-Flushing Head. Avoid Trapping Air in The Line.

Priming & Flushing The Self-Flushing Head With Methanol

Priming the Outgoing Self-flushing Head Line

Priming the Pumps

Decide which pump is to be used, A or B (it is recommended that both pumps are prepared for use in case of failure). If the pump is left in proper storage configuration, the intake lines (small tubes) will be in a bottle of isopropyl.

Remove the bottle of isopropyl alcohol bottle from the cap (with the pump intake lines inserted in it) and replace it with the bottle of tracer. Care should be taken to rotate the bottle while holding the cap steady so as not to twist the lines.

Unplug the data cable on the back of the pump in order to run the pump in manual mode.

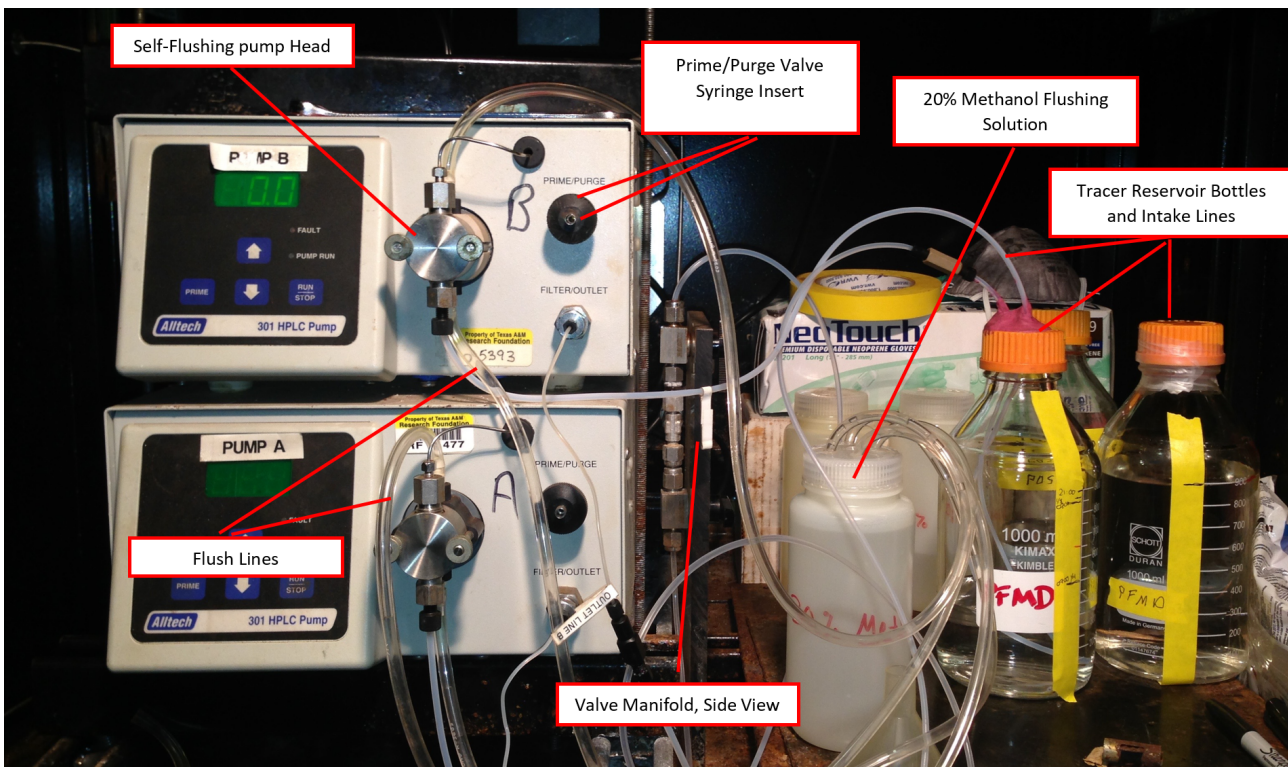
Be sure that all of the connections downstream of the prime/purge valve are closed.

Connect a syringe to the prime/purge valve. Open the prime/purge valve 1 – 2 turns counterclockwise.

Run the pump at a flowrate of 3 – 5 ml/min. Prime the pump by pulling mobile phase and any air bubbles through the system and into the syringe (a minimum of 20 mL). Waste can be placed into a waste bottle.

Stop the pump and close the prime/purge valve.

Once you are finished priming the pump with tracer and priming the self-flushing head with methanol your setup should look similar to the figure below.



Running Configuration of HPLC Pumps

Priming/Flushing the Distribution Lines

Now that the pump is primed, open the outlet valve for the 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 (most likely). 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 gate valve closed. Uncap the stainless steel line for the mud pump that will be used, remember to switch the output on the manifold that leads to the stainless steel line to the pump in use, 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.

Tracer Monitoring During Drilling

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.

The Operations Superintendent needs to setup Rigwatch to control the pump volume and to have the pump status (on/off) display on Rigwatch; generally one of the IODP engineers will be assigned. Note that Rigwatch will automatically adjust the HPLC pump rate when the Mud Pump rate rate increases or decreases to maintain the same ratio of PFT to drilling fluid. This ratio needs to be decided by the science party, but several expeditions have used 1 ppm.

TRACER WTACH

During operations, it is important to monitor the volume of PFT remaining so you know when to switch the bottles. 2 bottles of tracer should be kept with the pumps, one in use and one spare. Note the liquid level before the pump is turned on. Once the tracers are being delivered during coring, periodically check and note the liquid level on a log sheet kept in the Core Lab or LO office. When one bottle is nearly empty, ~100mL depending on your use, swap the use bottle for the spare and refill the empty bottle using the procedures outlined *Tracer Preparation* section at the star of this guide. Note the inlet tubes should be adjusted to suck-up the bottom of the bottle.

There is a web camera in the Pump Housing and can be viewed from any computer in the lab. Simply copy the following IP address into any browser; <http://192.168.1.110/view/view.shtml?id=30&imagepath=%2Fmjpg%2Fvideo.mjpg&size=1> The username and password is daq, daq. The LED light is not necessary, but can be turned on and off by tapping the end of the light.

While drilling, you can also monitor the pump status (on/off) and the pump rate using Rigwatch. Check this to see if the drillers turn the PFT pumps on when needed, like displacing the drill string prior to coring, and turn the PFT pumps off when not needed, like drilled intervals or mud sweeps. A link to a quick guide is below.

- [Rigwatch Set-up.pdf](#)

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 of the pump and lines. Refer to section 2.5.1 of the Alltech manual for instructions on preparing the pumps for storage. Basically, you will prime and flush the pump and lines with isopropyl alcohol. To do this, close the gate valves to the mud pump inlets and remove the stainless steel lines from the mud pump lines. Follow the same instructions as 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. **Remove all waste from the pump housing area and be sure all remaining bottles are labeled.**

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.

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:

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

Isopropyl Alcohol

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)

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.

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.

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

PPE

Gloves, Eye protection (Safety glasses)

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 the manual and an IODP ET to diagnose the problem, a fuse may have blown.
Fluid cannot be primed (pulled) into the pump	Inlet lines from the reservoir are clogged	Inspect the lines and if suspect they are clogged, replace the lines and clean fittings.
	Pump is clogged	Consult the manual for cleaning procedures.
Fluid does not exit the lines	Valve closed	Open valve
	Pump clogged	Consult the manual for cleaning procedures.
	Exit lines clogged	If pump is functional, the outlines may be clogged. Replace the lines.
Pump does not run with Rigwatch command	Data cable not connected	Confirm data cable is connected to operational pump and Ethernet server
	Network connection lost	Contact IODP IT support
	Equipment malfunction	Troubleshoot to determine which piece of equipment is malfunctioning.
Refer to Altech Manual, Section 6, for Further Troubleshooting		

Credits

This document originated from Word document MBIO Tracer pump_USG_371T_draft (see Archived Versions below for a pdf copy) that was written by L Crowder and edited by C Peng (2018-12-22). Credits for subsequent changes to this document are given in the page history.

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](#)

Archived Versions

- [MBIO Tracer pump_USG_371T_draft](#): An exported PDF version of this wiki page as of 2018-12-22.
- [PFT Pump Procedures Roys notes](#): An exported PDF version of this wiki page as of 2018-12-22
- [Rigwatch Set-up](#) : pdf notes 2017-02

Appendix

PFT Tracer pump Procedure Note (Roy Davis), 12/25/2014

Warning: Do not start the pumps till you are sure the lines are open and valves turned the right way. It will poop the small plastic lines.

Speaking of lines, the stainless ones coming from the pump to the drill water need to have the caps taken off, they also are filled with methanol for storage. The long one runs across the room to the inboard drill water line. So once you get the pumps and PFT sorted out uncap the line and pump PFT until they come out of the open line, then hook them up to the manifold and open the gate valve there on the side being used.

In the PFT box you will see the switching valve to route the PFT to either manifold.

Most of the time the drill floor uses the port pump, ask the driller or just see which is running.

NOTE to run the pumps you need to unplug them from the data cable which lets the rig floor run them it's should be unplugged but gets plugged into the data port on the back of the pump being used. Remember to plug back in when turning control over to the driller. and make sure the driller turns the pumps on they forget.

PFT

The PFT are not mixed they are used straight from the container. Decant from the big container into the dark glass bottles. It should be on with a metal funnel in the orange bucket in BHAZ stores.

The pumps are stored with Methanol; you need to prime it up

This is the flush side on the back of the pump face

There is a flush line that is as stored is in a loop this needs to be taken off one side and then placed in the methanol small bottle with two holes in the lid. Maybe four holes as it is used by both pumps. Only use one pump at a time.

Then place another hose to the run from the other side of the flush to the bottle.

The PFT are very volatile they will evaporate away if left uncorked.

The PFT line goes from the PFT bottle mark a level when running it, so as to see if it's getting used.

The manual shows how to prime the PFT line with a syringe on the front of pump where you will see a large wheel and place to put the syringe to pull thru the PFT

I would just pump and prime one pump and leave the other one as is until needed. Sorry if a little jumbled but it's xMAS eve and i'm home.