



*LIGO Laboratory*

T030036-00

***ADVANCED LIGO***

Feb. 25, 2003

**PUMP STATION  
FLUIDS**

K. Mailand

Distribution of this document:  
HEPI/SEI Group

This is an internal working note of the LIGO Project.

**California Institute of Technology**  
**LIGO Project – MS 18-34**  
**1200 E. California Blvd.**  
**Pasadena, CA 91125**  
Phone (626) 395-2129  
Fax (626) 304-9834  
E-mail: [info@ligo.caltech.edu](mailto:info@ligo.caltech.edu)

**Massachusetts Institute of Technology**  
**LIGO Project – NW17-161**  
**175 Albany St**  
**Cambridge, MA 02139**  
Phone (617) 253-4824  
Fax (617) 253-7014  
E-mail: [info@ligo.mit.edu](mailto:info@ligo.mit.edu)

**LIGO Hanford Observatory**  
**P.O. Box 1970**  
**Mail Stop S9-02**  
**Richland WA 99352**  
Phone 509-372-8106  
Fax 509-372-8137

**LIGO Livingston Observatory**  
**P.O. Box 940**  
**Livingston, LA 70754**  
Phone 225-686-3100  
Fax 225-686-7189

<http://www.ligo.caltech.edu/>

- 1 Introduction..... 3**
- 2 CIT / LASTI: FLUID REQUIREMENT SPECIFICATION..... 3**
- 3 Optical Contamination Goals and Test results ..... 4**
  - 3.1 Mineral Oil: Shell Vitrea #46..... 4**
  - 3.2 Water / Glycol: ‘Aquamil’ or ‘Houghto-Safe 419 TY’ ..... 4**
- 4 Fluid Choices for the LASTI Prototype ..... 6**
  - 4.1 Selected Fluid [Vendor Info.]..... 6**
  - 4.2 Others fluids considered:..... 6**
    - 4.2.1 Glycerin/Water and Glycerin/Ethyl Alcohol: ..... 6
    - 4.2.2 Alternate Glycol/Water Fluids not yet tested:..... 7

## 1 Introduction

This document describes the methods used and the types of fluids included in the selection process of the LASTI PUMP STATION Operating Fluid. The specification requirement for this fluid has evolved to include concerns regarding optical contamination in the event of a leak; and hydraulic system service over extended periods of continuous operation.

## 2 CIT / LASTI: FLUID REQUIREMENT SPECIFICATION

### Our operating conditions:

1. Approx Temp. 68/70 deg. F.
2. Operating Pressure Approx. 200 PSI
3. Flow Approx. 3.2 GPM
4. Continuous operation

### Hydraulic Fluid Requirements:

- 1) Non-hazardous (e.g. not extremely toxic)
- 2) Water soluble (or easily cleaned up)
- 3) Available in required viscosity, our requirement ~100cps @70F
- 4) Viscosity sensitivity with temperature is no worse than mineral oil.
- 5) Does not support biological growth.
- 6) Does not promote rust or corrosion; i.e. is compatible with the materials in our system.
- 7) Has sufficient lubricity for gear pumps (which may be used in our application)
- 8) Does not break down or coagulate or polymerize under the (very mild) conditions in our application.
- 9) No added dyes -- clear fluid
- 10) Meets the ASTM D-2882 wear standard [see description below]
- 11) Non-Flammable

### Description of wear test:

The standard test for lubrication and pump wear properties is ASTM D-2882. In this test, the hydraulic fluid is circulated through a Vickers Vane pump and a pressure relief valve at 2,000 psi and 175°F for 100 hours. The ring and vane components of the pump are weighed before and after the test to determine the total weight loss. Less weight loss indicates better lubrication and pump wear characteristics. Twenty milligrams is the maximum weight loss for a product to be considered an excellent anti-wear hydraulic fluid.

[See] Fluid Specification Document # E021116-B on file with the DCC

### 3 Optical Contamination Goals and Test results

The contamination allowable goal is XXXX parts per million. The two fluids Mineral Oil and Aquamil also known as [Houghto-safe 419TY] have been tested for optical contamination; however Mineral Oil has been ruled out for use because it doesn't meet the requirements of flammability and is not water-soluble. These two fluids indicate XXXX results in meeting that goal.

#### 3.1 Mineral Oil: Shell Vitrea #46

This fluid was initially used by the group at Stanford and at CIT and performed satisfactorily in the hydraulic operation of the pump and actuator system. Concerns about the possibility of optical contamination in the event of a leak and the difficulty of the 'clean-up' afterwards prompted a search for another type of fluid.

#### 3.2 Water / Glycol: 'Aquamil' or 'Houghto-Safe 419 TY'

This **water/glycol** mixture was chosen to test from vendors. samples and looked water clear. This fluid is water-soluble for easier clean up if necessary. The specs show it's compatible with the pump station mechanical hardware, and meets our overall specifications. Aquamil fluid was selected for initial LASTI system run. The results of the Aquamil optical contamination test are shown in: **Figures 1, 2 and 3 below.**

The results of the test are also on file under #XXXX in the DCC

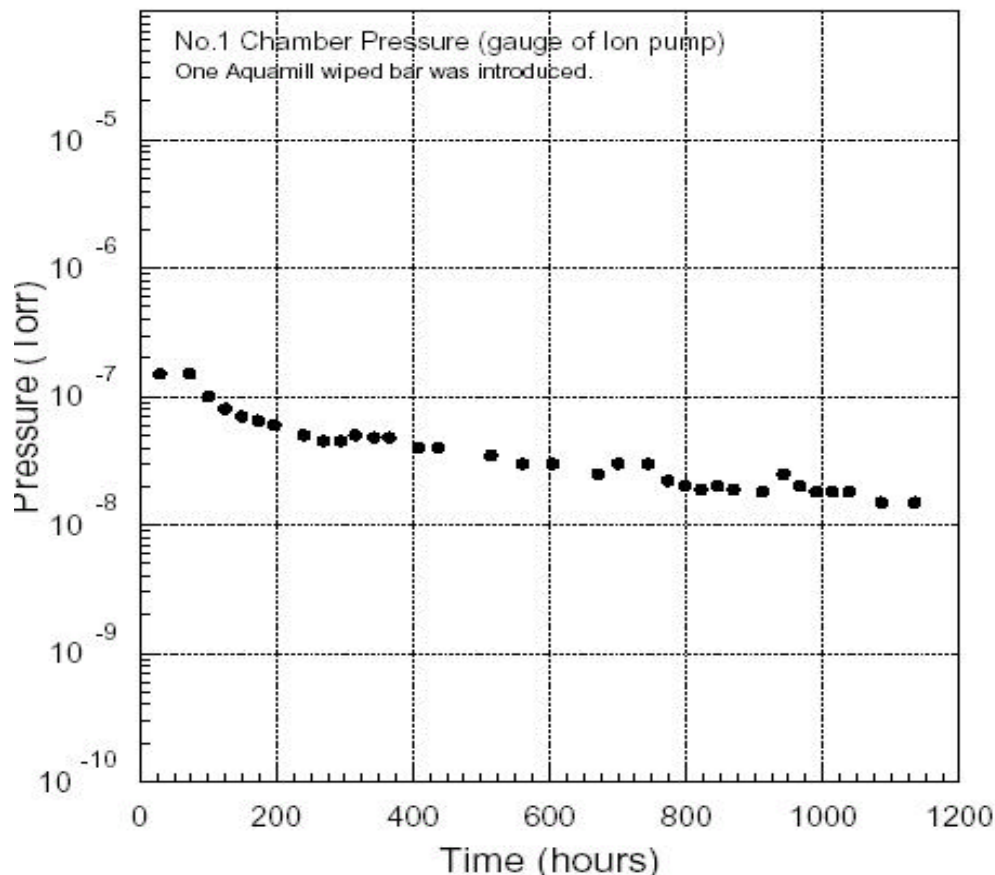


Figure 1 Pressure vs. Time

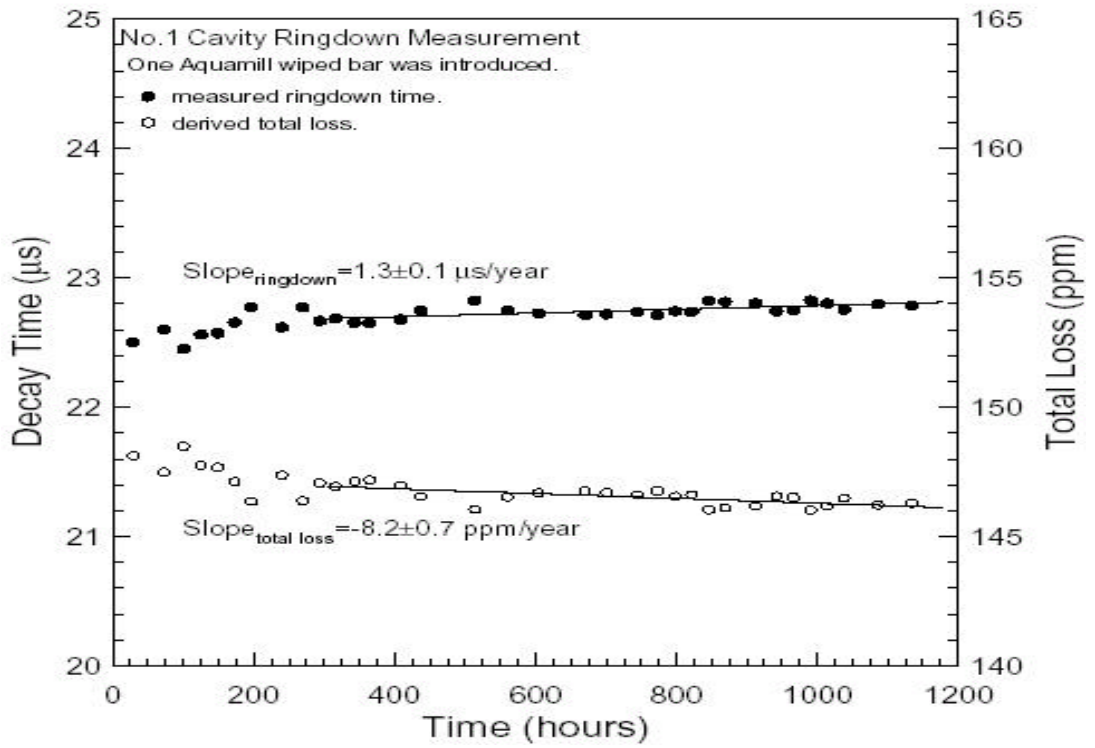


Figure 2 Ringdown Measurement

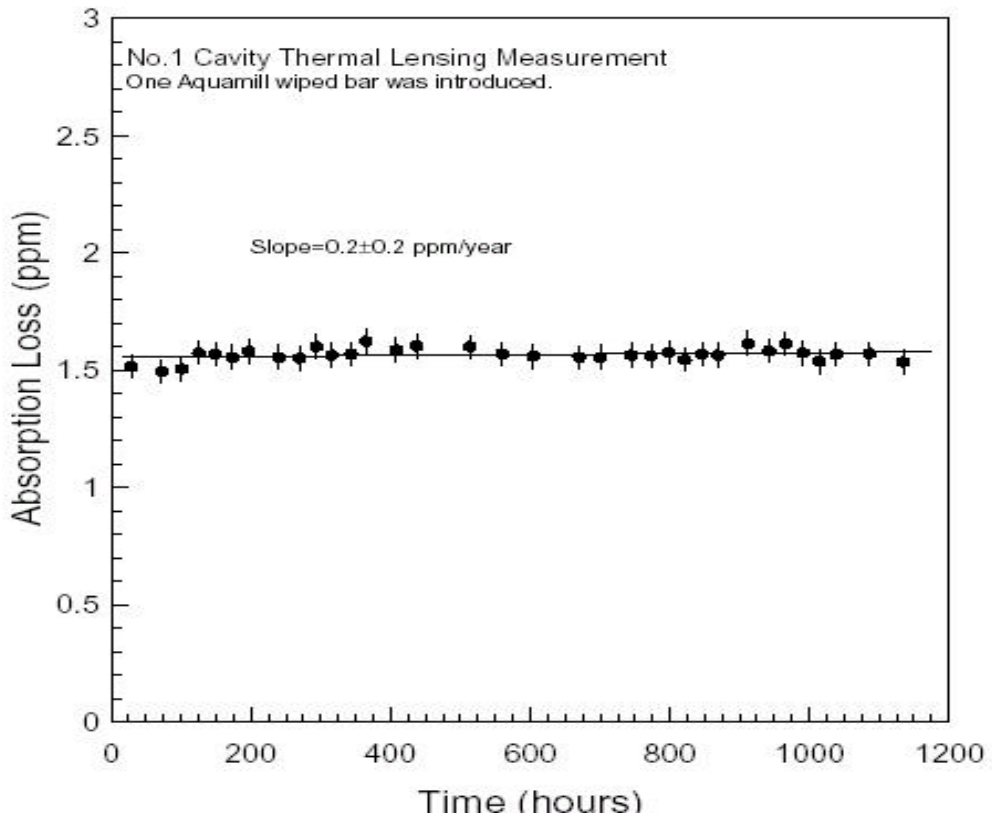


Figure 3 Thermal Lensing Measurement

## 4 Fluid Choices for the LASTI Prototype

The fluid selected for LASTI must be similar to the **Shell Vitrea #46** in respect to the viscosity and the viscosity curve in the temperature range we expect to operate. This is to be compatible with the existing system design which used the **Vitrea #46** fluid in the development of the resistor and servo-valve designs already in place.

### 4.1 Selected Fluid [Vendor Info.]

The LASTI fluid has the brand name of 'Aquamil' or Houghto-Safe 419 TY

The supplier of the fluid is in the US with a lab in South Carolina and has given us a set of specifications and MSDS re. the performance of the Aquamil fluid and some history and references on its use at other sites.

Supplier: Contact: Milad

Phone: 1-401-729-1300

Cell: 1-401-952-8890

Mfgr: Houghton International Inc.

Box 930

Valley Forge, PA 19482-0930

Phone: 610-666-4000

Chemist: Tony Noblit

Phone: 800-666-8269

### 4.2 Others fluids considered:

#### 4.2.1 Glycerin/Water and Glycerin/Ethyl Alcohol:

These fluids were not completely tested due problems issues with flammability of Ethyl Alcohol, or compatibility Glycerin/Water with the mechanical components in the system causing rust and corrosion. The corrosion resistance and lack of biocide properties, or the lack of lubricity for the pump bearings or seals; would require additional additives. Finding a 'in use' industrial fluid meeting our specifications requires less time than developing our own fluid mixture.

#### 4.2.2 Alternate Glycol/Water Fluids not yet tested:

Other water/glycol fluids are available and will meet our specifications they contain different additive packages. These additives may be similar re. optical contaminate properties or have different [better/ worse] properties for our pump or other system component life.

As time permits other brands of fluids using a mixture of glycol and water will be tested as alternates for the LASTI project or for use at the sites.

**Chem-Sol** fluid, this is a proven hydraulic fluid with a red dye additive, the manufacturer will omit the red dye for our application.

**Leander Lubricants** HSF 75-2 is a Hydro-Forming fluid, which has been mixed to meet our viscosity specs. [this fluid is currently being tested]

Other Glycol/Water mixtures are on the market and if necessary we can request samples of these fluids to test.