LIGO-E940029-00-B

FACSIMILE MESSAGE

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November 21, 1994

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Fax No. (818)304-9834

To: Larry Jones
LIGO Project Caltech Pasadena, California

From: M. L. Tellalian Phone (815)439-6517

Plainfield Engineering - PAE

RE: Cleaning Procedure and Assessment Procedures
LIGO Design & Qualification Test - Caltech Contract C146

Larry,

Attached are the following procedures for your review:

- CLTEST1 - This procedure describes the cleaning that is being done on the 7' trial section.
- CLBLEED1 - This procedure describes the bleeder detection method.
- CLDROP1 - This procedure describes the water drop assessment of the surface.
- CLSAMP1 - This procedure describes the steps to be followed in taking a longitudinal wash solvent sample. Currently, the procedure states that the amount of solvent 200 ml plus 5 ml per foot of tube. Per our conversation last week, Rai has requested that the amount of solvent used per foot be constant for all tube sections tested. The procedure will be revised to require 33.5 ml per foot of tube.

The safety provisions of the cleaning procedure are being reviewed by our Corporate Safety department. We are ready to start the solvent wash and should be released to do so by 2:00 PM our time. Let me know if you have any comments or questions.

Regards,

Marty

M. L. Tellalian
Plainfield Engineering

		IDENTIFICATION CLTEST1			
TITLE: TEST TO ASSESS THE EFFECTIVENESS OF CLEANING WITH LIQUID MERICHEM 500 AND ISOPROPYL ALCOHOL		REFERENCE NO. 930212		SHT 1 OF 5	
		OFFICE RCE		REVISION 0	
PRODUCT: LIGO BEAM TUBE MODULES QUALIFICATION TEST CALIFORNIA INSTITUTE OF TECHNOLOGY		MADE BY SWP	CHKD BY MLT	MADE BY	CHKD BY
		DATE 11/21/94	DATE 11/21/94	DATE	DATE

1.0 SCOPE:

1.1 This procedure covers the cleaning of a short section of the beam tube to assess the additional cleaning processes that are proposed for use on the QT and Option beam tubes sections. A Merichem 500 wash followed immediately by a pressurized water rinse has been added to the cleaning process before the steam cleaning operation and an alcohol wash followed by an alcohol rinse has been added to the cleaning process after the steam cleaning. Also, additional testing operations have been added to assess the effectiveness of the proposed cleaning methods. This procedure is to be completed and the results assessed before the QT beam tubes are final cleaned.

2.0 PERSONNEL CLOTHING REQUIREMENTS:

2.1 Personnel entering beam tube can sections during this cleaning procedure must wear clean room style clothing (coveralls, shoe covers, hair caps and gloves) to minimize further contamination of the beam tube being cleaned.

3.0 EQUIPMENT AND MATERIALS TO BE USED WITH THIS PROCEDURE:

3.1 Equipment:

- Blacklight Inspection equipment and materials . See Procedure BI1N.
- Equipment and materials for collecting liquid alcohol contaminant samplings. See Procedure CLSAMP1.
- Equipment and materials to assess bleeders on the surface. See Procedure CLBLEED1.
- Special end covers with inflatable seals to contain the alcohol liquid and vapor. See sketch SK-03.
- Turning rolls to roll the beam tube sections during the cleaning operation.
- A 90 gph steam generator
- The special steam spaying apparatus for spraying steam on the inside of the beam tube sections.
- Fire extinguishers suitable for use with flammable solvents.
- An air safety meter.
- Flexible air conduit for venting alcohol vapors from the beam tube to the paint spray booth ventilating system.
- HEPA filter to filter the air entering the beam tube during the venting of the alcohol vapors.
- Two spill containment boxes. One for each end of the beam tube.
- One or more fans to blow air away from the ends of the beam tube.
- Clean empty containers to collect and store spent alcohol.
- Brackets for mounting two cleaning witness coupons to the inside if the beam tube.
- Respirators for alcohol vapors.

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		OFFICE RCE		REVISION 0	
PRODUCT: LIGO BEAM TUBE MODULES QUALIFICATION TEST CALIFORNIA INSTITUTE OF TECHNOLOGY		MADE BY SWP	CHKD BY MLT	MADE BY	CHKD BY
		DATE 11/21/94	DATE 11/21/94	DATE	DATE

3.2 Materials:

- Liquid Merichem 500 cleaner. (0.2 gallons per foot of tube length)
- 2-Propanol (Isopropyl Alcohol) for alcohol wash and rinse. (0.4 gallons per foot of tube length)
- Deionized Water pressurized water and steam rinses. (6 gallons per foot of tube length).
- Fuel for the steam cleaner.
- Clean polyethylene and duct tape to seal the ends of the tube after cleaning is complete.
- Three 3/8 ' wide by 13" long cleaning witness coupons from typical 1/8" thick beam tube material.
- Wrapping film - Static Disapative Film Laminate, National Metalizing # N250-707 (distributed by Caltex Plastics as CP STAT 100).
- No smoking signs and warning tape.

4.0 PRECLEANING INSPECTION AND SPOT CLEANING:

4.1 Select one of the extra beam tube sections for the cleaning test Confirm that the section selected has not been previously cleaned and has typical bleeders. Do not use the 22-A or 22-B QT beam tube assemblies.

4.2 Take a cleanliness assessment sample per procedure CLSAMP1 and have it analyzed for contaminants.

5.0 WASH WITH LIQUID MERICHEM 500 AND PRESSURE RINSE

5.1 Attach Three (3) cleaning witness coupons to the inside of the beam tube.

5.2 Level the beam tube on the turning rolls. Level to within 1/4 inch from end to end of the beam tube.

5.3 Install polyethylene end covers to contain the cleaning solution. Tape the polyethylene to the outside of the beam tube. Install and tighten a nylon binders at the ends of the tube over the polyethylene to seal and hold in place.

5.4 Pour the Merichem 500 liquid into the section of beam tube. Use a quantity of Merichem equal to 200 milliliters for each foot of length of the beam tube.

5.5 Immediately start the turning rolls and rotate for 30 minutes at the rate of one third (1/3) of a turn per minute.

5.6 Stop rotating the tube after 30 minutes, slope the beam tube to a 1 : 20 slope and drain the Merichem liquid from the tube. Drain the Merichem into a clean container and save.

5.7 Pressure rinse each foot of beam tube with 3 gallons of Deionized water . Use the steam spraying apparatus to apply the rinse water. Cap one of the two spray nozzles to increase the pressure of the water being sprayed. Record the water pressure.

5.9 Steam clean the beam tube section with steam from deionized water at a rate of 3 gallons per foot.

		IDENTIFICATION CLTEST1			
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PRODUCT: LIGO BEAM TUBE MODULES QUALIFICATION TEST CALIFORNIA INSTITUTE OF TECHNOLOGY		MADE BY SWP	CHKD BY MLT	MADE BY	CHKD BY
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5.10 Allow the beam tube to dry before testing for cleanliness. If testing is not performed immediately after cleaning cover the ends of the beam tube to prevent contamination.

6.0 TESTS TO ASSESS EFFECTIVENESS OF THE WASH WITH MERICHEM 500

- Remove one of the cleaning witness coupons, wrap the coupon in the CP STAT 100 wrapping material and ship the coupon along with an uncleaned coupon to Rai Weiss at the following address:

  Rainer Weiss
  Room 20B145
  MIT
  18 Vasser Street
  Cambridge, MA 02139

- Perform the water break test per procedure CLDROP1.
- Take a cleanliness assessment sample per procedure CLSAMP1.
- Inspect the inside surface for bleeders per procedure CLBLEED1.

7.0 SPECIAL SAFETY PROVISIONS FOR THE ALCOHOL WASH AND RINSE OPERATIONS

7.1 Rope off the test area and place warning signs. Place warning tape and signs at doors and other accesses into the test area.

7.2 Open the high bay door and place a fan upstream of the beam tube being cleaned to blow air away from beam tube toward the high bay door.

7.3 Cover the gratings to the spill containers with plastic and position the grating to provide an opening large enough to handle spillage from the tube in case the end caps develop a leak during the alcohol cleaning and draining operation.

7.4 Turn on blower to the paint hood and open the butterfly valve to vent through the hood before starting the alcohol wash.

7.5 Provide a hole in the aluminum tube cap at the vent/drain end to permit sampling of the air inside the tube during the venting operation.

7.6 Place the air safety meter at the motor to the turning rolls and sample from the time the alcohol is poured into the beam tube until the alcohol has been drained and vented from the tube. If at any time during the alcohol cleaning process the LEL meter reading becomes greater than 10% of the LEL - turn the power off to the turning rolls, clear the area of all non essential personnel and determine the source of the vapors or leakage.

		IDENTIFICATION CLTEST1			
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		OFFICE RCE		REVISION 0	
PRODUCT: LIGO BEAM TUBE MODULES QUALIFICATION TEST CALIFORNIA INSTITUTE OF TECHNOLOGY		MADE BY SWP	CHKD BY MLT	MADE BY	CHKD BY
		DATE 11/21/94	DATE 11/21/94	DATE	DATE

7.7 Be prepared to shut down the building ventilation and area electrical in the case of a large alcohol liquid or vapor leak. Assign two of the cleaning personnel as emergency personnel for the cleaning operation.

7.8 Place fire extinguishers near each end of the beam tube being cleaned.

7.9 Monitor the air inside the beam tube during the venting operation to determine when it is safe to remove the end caps. LEL inside the beam tube must be less the 10% before the end caps can be remove and the beam tube vented to the room.

7.10 Prohibit access to the ends of the beam tube with the exception of the short periods to inspect the tube interior through the plexiglas window.

8.0 ALCOHOL WASH AND RINSE

8.1 Level the beam tube on the turning rolls. Level to within 1/4 inch from end to end of the beam tube.

8.2 Clean and install the aluminum end caps and inflate the seals. Pour a small amount of the isopropyl alcohol (about 300 milliliters) into the bottom of the each end cap and rotate to check for leakage. Be careful not to get the isopropyl alcohol on the inside surface of the beam tube. Cap the six inch vent line and install the 24" square Plexiglas window to seal the 22" square opening.

8.3 Pour the isopropyl alcohol directly into the beam tube through the drain valve or small opening in the cap on the 6" vent nozzle. Use .2 gallons of isopropyl alcohol per foot of tube length. Pour the alcohol into the tube as quickly as possible to minimize the amount of vapor that escapes during the pouring operation.

8.4 Immediately start the turning rolls and rotate the beam tube 4 turns at a rate of 1/2 turn per minute. Monitor the LEL reading near the turning rolls during the operation.

8.5 Slope the beam tube to 1:20 slope and drain the isopropyl alcohol from the beam tube into a clean covered storage container. Allow the tube to drain until the flow rate out of the tube is less than a drop every two seconds. Identify and save the drained alcohol.

8.6 Level the beam tube on the turning rolls. Level to within 1/4 inch from end to end of the beam tube.

8.7 Again pour isopropyl alcohol directly into the beam tube through the drain valve or small opening in the cap on the 6" vent nozzle. Use .2 gallons of isopropyl alcohol per foot of tube length. Pour the alcohol into the tube quickly to minimize the amount of vapor that escapes from the beam tube while pouring.

8.8 Immediately start the turning rolls and rotate the beam tube 4 turns at a rate of 1/2 turn per minute. Monitor the LEL reading near the turning rolls during the operation.

	IDENTIFICATION: CLTEST1			
TITLE: TEST TO ASSESS THE EFFECTIVENESS OF CLEANING WITH LIQUID MERICHEM 500 AND ISOPROPYL ALCOHOL	REFERENCE NO.: 930212		SHT 5 OF 5	
	OFFICE: RCE		REVISION: 0	
PRODUCT: LIGO BEAM TUBE MODULES QUALIFICATION TEST CALIFORNIA INSTITUTE OF TECHNOLOGY	MADE BY: SWP	CHKD BY: MLT	MADE BY	CHKD BY
	DATE: 11/21/94	DATE: 11/21/94	DATE	DATE

8.9 Slope the beam tube to 1 : 20 slope and drain the isopropyl alcohol from the beam tube into a clean storage container. Allow the tube to drain until the flow rate out of the tube is less than a drop every five seconds. Identify and save the drained alcohol.

8.10 Attach the six inch vent hose and install the 24" square HEPA filter and vent the vapors inside the beam tube through the paint hood exhaust system.

9.0 TESTS TO ASSESS EFFECTIVENESS OF ALCOHOL WASH AND RINSE

- Remove one of the cleaning witness coupons, wrap the coupon in the CP STAT 100 wrapping material and ship the coupon to Rai Weiss at the following address:

  Rainer Weiss
  Room 20B145
  MIT
  18 Vasser Street
  Cambridge, MA 02139

- Perform the water break test per procedure CLDROP1
- Take a cleanliness assessment sample per procedure CLSAMP1.
- Inspect the inside surface for bleeders per procedure CLBLEED1

10.0 DOCUMENTATION

10.1 Document as outlined in this procedure.

	IDENTIFICATION: CLBLEED-1			
TITLE: CLBLEED-1 BLEEDER DETECTION BY PROPANOL RINSE WITH BLACK LIGHT INSPECTION PRODUCT: LIGO BEAM TUBE MODULES QUALIFICATION TEST CALIFORNIA INSTITUTE OF TECHNOLOGY	REFERENCE NO.: 930212		SHT 1 OF 1	
	OFFICE: RCE		REVISION: 0	
	MADE BY: MLT	CHKD BY: SWP	MADE BY:	CHKD BY:
	DATE: 11/18/94	DATE: 11/21/94	DATE:	DATE:

1.0 SCOPE:

1.1 This procedure describes the methods to be used to investigate the beam tube surface for the presence of spot contamination as indicated by bleeding lines of fluorescence in a solvent wash when viewed under black light conditions.

2.0 BEAM TUBE ENTRY REQUIREMENTS:

2.1 This procedure can be used on the interior or exterior beam tube surfaces during any stage of the cleaning process. Personnel entering the tube must follow cleanliness procedures consistent with the condition of the tube at the time of entry.

3.0 EQUIPMENT AND MATERIALS TO BE USED WITH THIS PROCEDURE:

3.1 A minimum of 15 ml of reagent grade 2-propanol in a spray bottle. The spray bottle shall be equipped with a tapered nozzle with a pin hole which allows 5 ml of propanol to be applied to a vertical surface in 2 seconds.

3.2 Black light

3.3 Clean, lint free cloth.

4.0 GENERAL PROCEDURE:

4.1 Locate an area with a visual inspection under black light which is representative of the surface being tested. The area should be approximately 12" x 18". Avoid spiral welds and circumferential welds if possible.

4.2 Place the surface in a vertical plane. If an area of the tube is being tested, rotate the tube section such that the area is approximately 4" above and 14" below the horizontal centerline.

4.3 Place a cloth dam 14" below the horizontal center line to prevent propanol from running down the tube more than 14".

4.4 Using a spay bottle with a tapered snout and small discharge hole, apply approximately 5 ml of propanol at the horizontal centerline. The propanol should be applied by squeezing the spray bottle while sliding the snout horizontally over the 12" length in approximately 2 seconds.

4.5 Record the general characteristics of the fluorescence and the number of bleeders identified. Qualitatively assess the intensity of the bleeders and the overall intensity of the fluorescence.

4.6 Approximately 15 seconds after the first propanol wash, apply another 5 ml of propanol in the same fashion to the surface along a horizontal line 2" above the first wash.

4.7 Again record the characteristics of the fluorescence including the appearance of new bleeders and the condition of existing bleeders.

4.8 Approximately 15 seconds after the second propanol wash, apply another 5 ml of propanol in the same fashion to the surface along a horizontal line 2" above the second wash.

4.9 Again record the characteristics of the fluorescence including the appearance of new bleeders and the condition of the existing bleeders

	IDENTIFICATION CLDROP-1			
TITLE CLDROP-1 WATER DROP BREAK TEST FOR BEAM TUBE CLEANLINESS ASSESSMENT	REFERENCE NO. 930212		SHT 1 OF 1	
	OFFICE RCE		REVISION 0	
PRODUCT LIGO BEAM TUBE MODULES QUALIFICATION TEST CALIFORNIA INSTITUTE OF TECHNOLOGY	MADE BY MLT	CHKD BY SWP	MADE BY	CHKD BY
	DATE 11/21/94	DATE 11/21/94	DATE	DATE

1.0 SCOPE:

1.1 This procedure describes the methods to be used to assess the beam tube surface cleanliness as indicated by the characteristics of water drops placed on a horizontal surface of the tube.

2.0 BEAM TUBE ENTRY REQUIREMENTS:

2.1 This procedure can be used on the interior or exterior beam tube surfaces during any stage of the cleaning process. Personnel entering the tube must follow cleanliness procedures consistent with the condition of the tube at the time of entry.

3.0 EQUIPMENT AND MATERIALS TO BE USED WITH THIS PROCEDURE:

3.1 De-ionized water.

3.2 Container with a squeeze dropper.

3.3 Clean, lint free cloth.

4.0 GENERAL PROCEDURE:

4.1 Locate three areas by visual inspection under black light which are representative of the surface being tested. Each area should be approximately 6" x6".

4.2 Place the surface in a horizontal plane.

4.3 Using the squeeze dropper, place approximately 15 single drops of water on the surface of one area. Release the drop from the end of the pipette as close to the surface as possible without allowing the drop to be simultaneously in contact with the pipette and the surface. Allow sufficient space between each drop such that the drops do not run together.

4.4 Describe the profile of the water drops including the height of the drop, the diameter of the drop, and the angle between the drop profile and the surface measured from inside the drop. Qualitatively describe the behavior of the water drops for the first minute after the drop is placed on the surface. Record the general characteristics of the water drops.

4.5 Repeat the test on the two other areas.

4.6 Wipe the water drops off the surface with clean, lint free cloth following the test.

		IDENTIFICATION CLSAMP1			
TITLE PROCEDURE FOR OBTAINING A CLEANLINESS ASSESSMENT SAMPLE		REFERENCE NO. 930212		SHT 1 OF 2	
		OFFICE RCE		REVISION 0	
PRODUCT LIGO BEAM TUBE MODULES QUALIFICATION TEST CALIFORNIA INSTITUTE OF TECHNOLOGY		MADE BY WLR	CHKD BY MLT	MADE BY	CHKD BY
		DATE 11/8/94	DATE 11/21/94	DATE	DATE

1.0 SCOPE

1.1 This procedure details the steps to be followed to obtain a cleaning assessment sample to quantify the surface contaminants from the inside of a section of beam tube. The liquid alcohol sample that is obtained from this procedure will be chemically analyzed to determine the types and amounts of contaminants that have been dissolved in the alcohol from the inside surface of the beam tube.

2.0 EQUIPMENT AND MATERIALS

- Isopropyl Alcohol
- A graduated cylinder to measuring the alcohol.
- A 4" diameter funnel
- Three 100 milliliter sample containers.
- Stop watch.

3.0 SUPPLEMENTAL METHODS

3.1 Rotate the beam tube such that the selected sampling area is along the bottom of the beam tube. The area selected should be representative of the general beam tube condition. For the initial sampling of a beam tube not cleaned, the beam tube shall be rotated out of the storage, fabrication, or installation positions. For the ensuing test samples the beam tube shall be rotated out of the mentioned positions and the positions where witness coupons are attached or previous test samples have been taken. Mark the location of the test samples on the outside of the beam tube.

3.2 Take a cleanliness assessment sample as follows:

3.2.1 Slope the beam tube to a 1:20 slope. The expansion joint shall be at the high end of the beam tube.

3.2.2 Place a clean sample collection container at lower end of the beam tube. The container shall be thoroughly cleaned with isopropyl alcohol and dried before use.

3.2.3 Measure length of beam tube. Do not include the expansion joint assembly. The amount of isopropyl alcohol shall be 200 milliliter + 5 milliliter per foot of beam tube length. Measure isopropyl alcohol into a thoroughly cleaned container/delivery system that is equipped to release isopropyl alcohol at a constant flow rate. Measure from the same batch of alcohol a 100 milliliter sample of the uncontaminated isopropyl alcohol and mark the container for comparison testing.

2.2.4 Release the isopropyl alcohol at the upper end below the expansion joint when applicable. The stream shall be kept narrow at the bottom inside of the beam tube. A rate of approximately ten (10) milliliter per second flow will develop a 4" wide channel that should be maintained by stop/start of flow.

		IDENTIFICATION CLSAMP1			
TITLE PROCEDURE FOR OBTAINING A CLEANLINESS ASSESSMENT SAMPLE		REFERENCE NO. 930212		SHT 2 OF 2	
		OFFICE RCE		REVISION 0	
PRODUCT LIGO BEAM TUBE MODULES QUALIFICATION TEST CALIFORNIA INSTITUTE OF TECHNOLOGY		MADE BY WLR	CHKD BY MLT	MADE BY	CHKD BY
		DATE 11/8/94	DATE 11/21/94	DATE	DATE

2.2.5 Time the flow to determine the amount of time it takes the channel to reach the lower end. Continue the isopropyl alcohol flow until the measured quantity is gone from the container.

2.2.6 Allow the isopropyl alcohol to flow into an thoroughly cleaned funnel and the sample collection container at the lower end. Collect 100 milliliter of sample and continue the collection into a second sample container until the flow is stopped and the droplets are more than two seconds apart.

2.2.7 Measure the amount of isopropyl alcohol collected in the sample collection container at the lower end. Mark the collection container with the sample identification code. Record the assembly piece mark, the test area location, the volume of amount of isopropyl alcohol delivered into the upper end of the beam tube assembly, the volume of sample collected at the lower end, and the sample identification code and the sample description (Clean Test - After initial spot cleaning, 1st sample, 1' - 6" from 0º to 90º, Sample #1a).