



TITLE CLEANING OF BEAM TUBE CAN SECTIONS PRODUCT LIGO BEAM TUBE MODULES QUALIFICATION TEST CALIFORNIA INSTITUTE OF TECHNOLOGY		IDENTIFICATION CL4 LIGO-E950062-03-B			
		REFERENCE NO. 930212		SHT 1 OF 4	
		OFFICE RCE		REVISION 3	
		MADE BY SWP	CHKD BY WLR	MADE BY SWP	CHKD BY KSD
DATE 11/29/94	DATE 11/30/94	DATE 2/17/97	DATE 3/17/97		

1.0 SCOPE:

1.1 This procedure covers the final cleaning of the beam tube assemblies. The inside surface of each of the beam tube assemblies will be cleaned using an application of a 1:30 solution of Mirachem 500 to deionized water and then followed by a steam rinse with deionized water (without the Mirachem 500).

2.0 PERSONNEL CLOTHING REQUIREMENTS:

2.1 Personnel entering the beam tube assemblies during this cleaning process must wear clean room style clothing (coveralls, shoe covers, hair caps and gloves) to minimize further contamination of the beam tube assembly. See the Material Safety Data Sheet (MSDS) for the appropriate Personal Protective Equipment (PPE).

3.0 EQUIPMENT AND MATERIALS TO BE USED WITH THIS PROCEDURE:

3.1 Equipment: (See attached Sketch 1, "Beam Tube Cleaning Equipment")

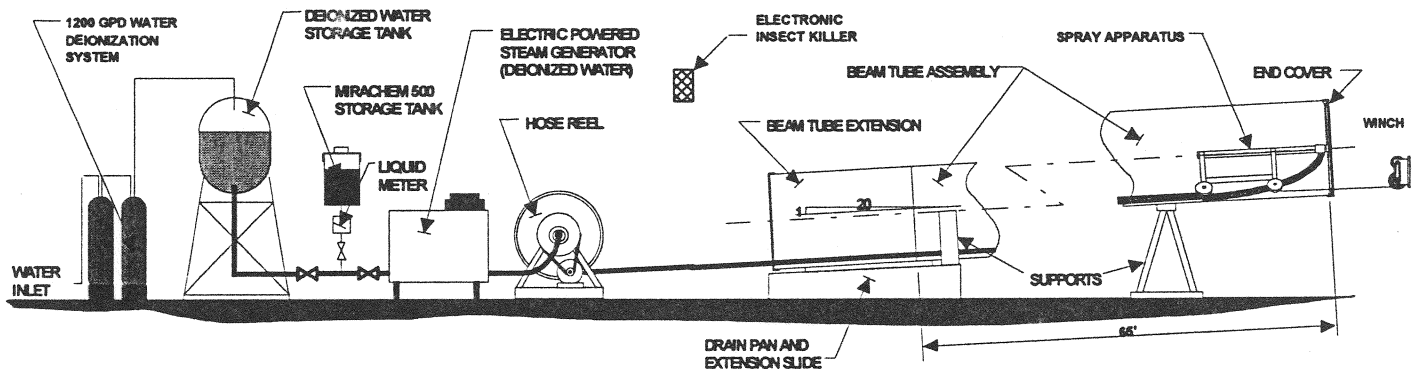
- A water deionization system that will provide 1500 gallons of processed water per day with a minimum resistivity of 2 MegOhms-cm. Approximately 350 gallons of deionized water is required to clean each tube.
- A resistivity meter to monitor the resistivity of the deionized water.
- A 1200 gallon tank for storing the deionized water.
- A dispensing tank for the Mirachem 500 and a liquid metering system to mix the Mirachem 500 with the deionized water.
- An electric powered steam generator that provides a water flow rate of 3 gallons per minute at 240 deg. F.
- A hand held trigger gun with steam hose for manual cleaning.
- A electric powered hose reel with a stainless reel and approximately 80 feet of steam hose. The hose reel drive system will be designed to pull the steam spraying apparatus through the beam tube assembly at a constant speed of 1 foot per minute.





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- A spraying apparatus for spraying Mirachem 500 solution and steam on the inside surface of the beam tube sections. The spraying apparatus shall be configured to apply the Mirachem 500 solution and steam through four rotating wands while the spraying apparatus is moved through the inside of the beam tube. Spray nozzles shall be attached to the ends of the each wand and the wands configured to position the nozzles approximately 2" from the inside surface of the beam tube. The nozzles shall be angled to apply the nozzle will provide a 60 to 90 degree flat spray pattern, with the pattern plane parallel to the beam tube axis.
- A beam tube extension assembly. (this extension attaches to the low end of the beam tube assembly and is used to park the spray apparatus).
- A drain pan to catch the run off.
- An aluminum cover to close the upper end and a plastic tarp to close the lower end of the beam tube during the steam cleaning process.
- Support saddles to position the beam tube assembly at a 1:20 slope.
- A surface thermometer to measure the temperature of the beam tube material.
- A wet vacuum cleaner (used to clean the inside of the expansion joints).
- An electric powered winch with 80 feet of stainless steel cable.
- An electronic insect killer (install inside clean room to kill flying insects).



SKETCH 1
BEAM TUBE ASSEMBLY CLEANING EQUIPMENT



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3.2 Materials:

- Liquid Mirachem 500 cleaner (1/2 gallon per tube).
- Deionized water with a resistivity of 2 MegOhms-cm minimum (approximately 350 gallons per tube).
- Protective end covers as described in LIGO drawing ER-311 and 1/2" wide stainless steel banding material to secure the covers to the ends of the beam tubes. A .45 micron vent filter with a filtration area of 400 cm sq. will be attached to one cover.
- Polyethylene bags and banding material to cover the ends of the tubes after cleaning process is completed.

4.0 PRECLEANING OPERATIONS:

- 4.1 For tubes with expansion joints, clean the inside surface of the expansion joint with alcohol. Scrub with scotch brite pad and wipe with lint free cloth to remove loose particles.
- 4.2 Lift the beam tube and set in the cleaning station. For the beam tube assemblies with expansion joints, the expansion joint is to be positioned at the high end of the cleaning station. Move the beam tube cleaning extension assembly into place at the lower end of the beam tube.
- 4.3 Rinse the inside surface of the expansion joint using cold deionized water. Vacuum water and loose particles from the bottom of the expansion joint using a wet vacuum cleaner.
- 4.4 Attach the aluminum cover to the high end of the beam tube assembly and attach the end of the winch cable to the spray apparatus in the beam tube extension assembly at the low end of the beam tube.

5.0 APPLICATION OF MIRACHEM 500:

- 5.1 Open the Mirachem 500 metering valve and turn on steam generator pump with heaters off. After the Mirachem 500 is spraying from the wands begin winching the spraying apparatus up the inside of the beam tube at a speed of approximately 6 feet per minute. Stop the spray apparatus before it contacts the aluminum cover at the upper end of the beam tube. Close the Mirachem 500 metering



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valve and continue spraying deionized water at the upper end of the beam tube to purge the Mirachem 500 from the system.

****** Caution ******

Do not allow the inside surface of the beam tube dry until the rinse is completed. This may require an additional application.

5.2 After 15 minutes of purging the Mirachem 500 from the system turn on the heaters to the steam generator. When the temperature of the steam reaches approximately 240°F, manually steam clean the outside surface at the upper end of the beam tube with the hand held trigger gun.

6.0 RINSING WITH STEAM:

6.1 With the cleaning apparatus at the upper end of the beam and steam at approximately 240 deg. F is being discharged from the rotating spray wands activate the power hose reel.

6.2 With the steam generator set to pump at 3 gallons per minute, steam clean the inside surface of the beam tube assembly with steam generated from deionized water (without Mirachem 500). The hose reel will retract the spraying apparatus at 1 foot per minute.

6.3 Stop the cleaning apparatus about 1 foot from the lower end of the beam tube assembly. Steam clean the outside surface of the lower end of the beam tube assembly using the hand held trigger gun. As soon as the outside surface is clean continue cleaning the last foot of the inside surface of the beam tube assembly.

6.4 Remove the cover from the ends of the beam tube assembly. For tubes with expansion joints, remove the water that is trapped in the flutes of the expansion joint using the wet vacuum cleaner.

6.5 The upper end of the beam tube assembly can be raised to accelerate draining and drying of the inside surface of the beam tube.

6.6 Confirm that the inside surface of the beam tube is dry. When required, obtain an alcohol sample for FTIR analysis per CLSAMP1, " Procedure for Obtaining a Cleanliness Assessment Sample". A



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sample is required from each of the first ten (10) cleaned beam tube assemblies and than one from at least every tenth cleaned beam tube assembly there after.

6.7 Attach the protective end covers and seal the ends of the beam tube assembly with polyethylene bags.

7.0 DOCUMENTATION

7.1 Document the final cleaning of each beam tube assembly on a Tube Cleaning Check List. As a minimum record the following information:

- The identification number of the beam tube assembly.
- The person(s) performing the cleaning.
- The date and time of cleaning.
- Room ambient temperature and humidity.
- Resistivity of water (2 MegOhms-cm minimum)
- Gallons of water used during Mirachem 500 application cycle.
- Gallons of Mirachem 500 used.
- Tube temperature during Mirachem application.
- Gallons of water used during rinse cycle.
- Tube temperature during rinse.

Sign and date each beam tube Quality Plan upon completion of final cleaning.