

**New Folder Name** Man Hour Estimate  
for Module Leak Testing  
T950023

LIGO-T950023-00-B



1501 North Division Street  
Plainfield, Illinois 60544-8929

# FACSIMILE MESSAGE

Fax No. is: 815 439 6010  
Verify No. is: 815 439 6000

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April 14, 1995

To: Larry Jones  
LIGO Project Caltech Pasadena, California

Fax No. (818)304-9834

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

Plainfield Engineering - PAE

RE: Man-hour Estimate For Module Leak Testing

Larry,

Attached are a couple of pages which describe the basic tasks associated with module leak testing with estimated man-hours. The task durations are difficult to estimate and the leak testing will be a cooperative effort between CBI and Caltech so it is difficult to estimate the total man-hours required for CBI's effort.

Let me know what you think of both the listing of tasks and the estimated man-hours. Thanks.

Regards,

A handwritten signature in cursive script that reads "Marty".

M. L. Tellalian  
Plainfield Engineering

### Module Leak Test Estimate for the QTR Update

CBI has estimated the price of two scenarios in accordance with the letter sent to Caltech on March 22. Budgetary prices are based on the following assumptions:

1. Air signature analysis is effective in determining the module leak rate and in locating a leak within an area of tube 100' long.
2. All equipment associated with the air signature analysis and data acquisition is supplied by Caltech. The system is designed and built by Caltech to be a test pod which attaches to the 10" valve at each port. Pods are factory tested and designed to be easily attached and removed. Pods consist of the including the following items:
  - All RGA's required.
  - All 10" valves required.
  - All cold traps and pumping systems.
  - Local fittings and utilities.
  - Rack mounted components.
  - Bake out provisions including insulation and heating elements.
  - All calibrated leaks and associated calibration equipment.
  - All computers and controllers required for data acquisition and operation.
3. Vacuum equipment for the pumpdown of the beam tube will be installed and operated by others.

The module leak test will consist of the following steps:

1. CBI will attach the test pods, wiring from 19" rack, and the pre-fabricated LN2 piping. 16 man-hours per pod or 144 Mhrs per module.
2. CBI will leak test the pump port components. 20 man-hours per pod or 180 Mhrs per module.
3. Installation of the data acquisition system to a central computer. 16 man-hours.
4. CBI will monitor the system during pump down of the module. 2 men for one week or 80 Mhrs.
5. Calibration of each RGA. 32 Man-hours for each RGA in the first module or 288 Mhrs per module one. Assume 144 Mhrs for modules 2 through 4.
6. Data acquisition will be performed by CBI with supervision and consulting by Caltech. 2 men for one week or 80 Mhrs per module.
7. Caltech will perform the data analysis and report on of the two results to CBI:
  - No leaks exist prior to the tube bake out. Proceed with the bake out in step number 13.
  - The module contains one leak greater than  $1 \times 10^{-5}$  torr liter per second.
8. CBI will monitor the system while Caltech operates the valves and pumping system to locate the leak within a 100' area of the tube prior to the bake. 32 Man-hours for leak location.
9. CBI will provide all the equipment and man-hours necessary to pinpoint the location of the leak by HMS testing. 120 Mhrs for leak location.
10. The leak will be repaired by back filling the tube with nitrogen and repairing the leak from the outside without the need for access inside the tube. The repair will be assumed to consist solely of a wash cover pass from the outside to seal the leak. 24 Mhrs
11. The leak will be tested by HMS leak testing and found to be repaired successfully. 16 Mhrs.
12. Air signature analysis will confirm the leak tightness of the module after repair prior to the bake. 24 Mhrs.
13. Bake out begins. CBI will provide man-hours to monitor the air signature of the module during bake out. Data will be provided to Caltech throughout the 30 day bake out. No equipment or man-hours will be assumed for execution of the bake out. Caltech will operate the 48" valves and pumping system as required to support the air signature analysis. CBI will provide one person for 8 hours every day with overtime premium or 320 Mhrs per module.
14. Following the bake out, Caltech will report one of the two results to CBI:
  - The module meets the specified leak tightness requirement. Proceed to step 20.
  - The module contains a leak between  $1 \times 10^{-9}$  and  $1 \times 10^{-5}$  torr liter per second.
15. CBI will monitor the system while Caltech operates the valves and pumping systems to locate the leak somewhere within a 100' length of tube. 48 Mhrs.

16. CBI will provide all the equipment and man-hours necessary to pinpoint the location of the leak by HMS testing. 120 Mhrs.
17. The leak will be repaired by back filling the tube with nitrogen and repairing the leak from the outside without the need for access inside the tube. The repair will be assumed to consist solely of a wash cover pass from the outside to seal the leak. 24 Mhrs.
18. The leak will be tested by HMS leak testing and found to be repaired successfully. 16 Mhrs.
19. Air signature analysis will confirm the leak tightness of the module after repair following to the bake. Additional bake out will not be required. 24 Mhrs.
20. CBI will remove all leak test equipment except for the 10" valve which remains in place. 12 Mhrs per pod or 108 Mhrs per module.

Manhours required for the first Module Leak Test without leaks is 1216 Mhrs.

Manhours required for the other module leak tests at the site without leaks is 1072 Mhrs.

Additional man-hours required if the module contains a leak prior to bake is 216 Mhrs.

Additional man-hours required if the module contains a leak after the bake is 232 Mhrs.

Total Mhrs required for module leak testing at each site is 4880 Mhrs.