



PROCESS SYSTEMS INTERNATIONAL, INC.

FEDERAL EXPRESS

TO : CALTECH (LIGO)
391 S. HOLLISTON AVE.
LIGO PROJECT MS 51-33
PASADENA, CA 91125

DATE : 01/10/96
TRANS. NO. : CT014
PROJECT NO.: V59049

ATTN : LINDA TURNER

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THE FOLLOWING [ ] DRAWINGS
[ ] DOCUMENTS
[ X ] SPECIFICATIONS

[ X ] ARE ATTACHED
[ ] SENT SEPARATELY

Table with 5 columns: Document No., Rev., Title, Dwg. Size, Sheets. Row 1: V049-2-011, 0, CLEAN AIR SUPPLY SYSTEMS, A, 5.

CC :

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**SPECIFICATION FOR  
CLEAN AIR SUPPLY SYSTEMS**

FOR

**LIGO VACUUM EQUIPMENT**

Hanford, Washington  
and  
Livingston, Louisiana

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JAN 10 1996

Information contained in this specification and its attachments is proprietary in nature and shall be kept confidential. It shall be used only as required to respond to the specification requirements, and shall not be disclosed to any other party.

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| PI       | TMS 9-26-95  |              | REVISED FOR UPDATED PRELIMINARY DESIGN |

| PROCESS SYSTEMS INTERNATIONAL, INC. |          |         |          | SPECIFICATION |                                    |      |
|-------------------------------------|----------|---------|----------|---------------|------------------------------------|------|
| INITIAL APPROVALS                   | PREPARED | DATE    | APPROVED | DATE          | Number                             | Rev. |
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Title

# SPECIFICATION FOR CLEAN AIR SUPPLY SYSTEMS

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## 1.0 SCOPE

This specification covers the minimum requirements for the design, materials, fabrication, assembly, inspection, testing, preparation for shipping, shipment and delivery of clean air supply systems for the LIGO vacuum system. The systems will supply clean and dry air for equipment venting and purging, and for air showers in various vacuum vessels.

All attachments are incorporated herein by reference and made a part of this specification.

The specified equipment is intended for use as part of the Vacuum Equipment supplied for the Laser Interferometer Gravitational-Wave Observatory (LIGO). LIGO, which is operated by Caltech and MIT under an NSF grant, includes two sites (Hanford Reservation, near Richland, WA and Livingston, LA). Each site contains laser interferometers in an L shape with 4 km arms, a vacuum system for the sensitive interferometer components and optical beams, and other support facilities.

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## 2.0 SCHEDULE

2.1 Equipment delivery shall be as follows:

|                  | <u>Quantity</u> | <u>Date</u> |
|------------------|-----------------|-------------|
| Washington Site: |                 |             |
| 50 CFM           | 4               | 9/1/97      |
| 200 CFM          | 1               | 9/1/97      |
| Louisiana Site:  |                 |             |
| 50 CFM           | 2               | 3/1/98      |
| 200 CFM          | 1               | 3/1/98      |
| Total Required   |                 |             |
| 50 CFM           | 6               |             |
| 200 CFM          | 2               |             |

2.2 Acceptances at the sites are expected to occur on a staggered basis, with final acceptance at Washington expected to occur about May 31, 1998, and about November 30, 1998 in Louisiana.

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### 3.0 EQUIPMENT REQUIREMENTS

The clean air supply systems will be used to provide air for equipment venting and purging, and for air showers in various vacuum chambers. The air at the supply point shall be 50 CFM (6 systems) or 200 CFM (2 systems) minimum. It shall be filtered through prefilters and HEPA filters to provide air meeting Fed. Std. 209 Class 100. It shall be dried to -60 C dew point (at atmospheric pressure), and provided at a minimum pressure of 30 psig. Supply air to the systems will be ambient indoor air. Air compressors shall be non-lubricated with filtered suction.

As a minimum, the following components shall be provided:

- A receiver with automatic start/stop capabilities for the compressor. (System operation will be continuous for periods of several hours to several weeks, with variable flow rates.)
- Hydrocarbon removal adsorbers.
- An inlet air filter to be mounted indoors by others, taking air from an adjacent room.
- Dryer blowdown silencers suitable for locating outside of the building by others.

### 4.0 DESIGN REQUIREMENTS

#### 4.1 Mechanical Requirements

- 4.1.1 Systems of each size shall be self-contained and identical to minimize the number of required spare parts.
- 4.1.2 Any required utility connections (such as for cooling water) shall be manifolded to a single connection point and terminated appropriately (such as with an isolation valve).
- 4.1.3 The acoustic noise and vibration requirements detailed in Section 5.1 of Attachment B do not apply to the clean air supply systems. However, reasonable measures shall be taken to minimize vibration.
- 4.1.4 The filters and all downstream materials shall be stainless steel (304, 304L, 316 or 316L).
- 4.1.5 Water cooled equipment is preferred if it results in a lower cost than air cooled.

#### 4.2 Electrical Requirements

##### 4.2.1 Instrumentation Requirements

Appropriate gauges for local operation and monitoring shall be provided.

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## 4.2.2 Controls Requirements

4.2.2.1 Controls for local operation shall be provided. In addition, provide terminal strips in junction boxes with dry contacts to indicate that the systems are running or not.

4.2.2.2 Systems shall be stopped and started by hand switches located on the system skid. The compressors shall be started and stopped automatically based on pressure in the discharge receiver tank.

## 4.2.3 Power Requirements

Required controllers and overload protection shall be provided on the system skids.

## 5.0 REQUIRED DOCUMENTATION

In addition to the documentation listed in Attachment B, the following documentation shall be provided prior to shipment:

- System installation and operating manual

## 6.0 SHOP TESTING

The Vendor shall perform his standard testing plus measurements of flow, dewpoint and particle count for the delivered air.

## 7.0 INSPECTION

The inspections called for in Attachment B shall be performed by the Vendor.

## 8.0 WARRANTY

Refer to PSI Specification V049-2-034, Purchased Equipment Commercial Requirements, for warranty requirements.

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ATTACHMENT "A"  
LIGO QUALITY ASSURANCE REQUIREMENTS SUMMARY

|   |                      |                  |                 |                            |                      |   |
|---|----------------------|------------------|-----------------|----------------------------|----------------------|---|
| LIGO VACUUM EQUIPMENT                       | VENDOR:              |                  |                 |                            |                      | JOB NO.: V59049                         |
| EQUIPMENT: CLEAN AIR SUPPLY SYSTEMS         | VENDOR ENG. OFFICE:  |                  |                 |                            |                      | DWG. NO.:                               |
| PSI P.O. NO:                                | VENDOR FACTORY:      |                  |                 |                            |                      | SPECNO: V049-2-011                      |
| TESTING INSPECTION AND DOCUMENTATION RECORD | Submittal After P.O. | Witnessed by PSI | Approval by PSI | Copies Req'd for PSI Files | Record in Mfr's File | Remarks:<br><br>Inspector:<br><br>Date: |
| MILESTONE SCHEDULE                          | 2 wk                 |                  | X               | 2                          | X                    |   |
| VENDOR Q.A. PLAN                            | 2 wk                 |                  | X               | 2                          | X                    |   |
| CLEANING PROCEDURE                          | 2 wk                 |                  | X               | 2                          | X                    |   |
| PREP FOR SHIPMENT PROCEDURE                 | 6 wk                 |                  | X               | 2                          | X                    |   |
| Deleted                                     |                      |                  | X               | 2                          | X                    |   |
| ASSEMBLY DRAWINGS                           | 6 wk                 |                  | X               | 2                          | X                    |   |
| DESIGN REVIEW                               |                      | X                |                 |                            | X                    | Prior to release for fabrication        |
| Deleted                                     |                      |                  |                 | 2                          | X                    |   |
| Deleted                                     |                      | X                |                 | 2                          | X                    |   |
| OPERATION & MAINTENANCE MANUALS             | 8 wk                 |                  |                 | 5                          | X                    |   |
| SHOP TEST PLAN                              |                      |                  | X               | 2                          | X                    | Prior to release for fabrication        |
| SHOP TEST (WITH REPORT)                     |                      | X                |                 | 2                          | X                    | Prior to release for shipment           |
|   |                      |                  |                 |                            |                      |   |