



PROCESS SYSTEMS INTERNATIONAL, INC.

FEDERAL EXPRESS

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

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ATTN : LINDA TURNER

SENT BY : RICH BAGLEY

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

[X] ARE ATTACHED
[] SENT SEPARATELY

| Document No. | Rev. | Title | Dwg.Size | Sheets |
|--------------|------|--------------------------------|----------|--------|
| ① V049-2-001 | 2 | ROUGHING PUMP CARTS | A | 9 |
| ② V049-2-002 | 3 | MAIN TURBOMOLECULAR CARTS | A | 8 |
| ③ V049-2-003 | 2 | AUXILIARY TURBOMOLECULAR CARTS | A | 7 |
| ④ V049-2-033 | 2 | GENERAL EQUIPMENT REQUIREMENTS | A | 14 |

- ① LIG0-E960004-02-V
- ② LIG0-E960005-03-V
- ③ LIG0-E960006-02-V
- ④ LIG0-E960007-02-V

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**SPECIFICATION FOR
AUXILIARY TURBOMOLECULAR PUMP CARTS
FOR
LIGO VACUUM EQUIPMENT**

Hanford, Washington
and
Livingston, Louisiana

PREPARED BY: David Moore

QUALITY ASSURANCE: Alan R. Burdick

TECHNICAL DIRECTOR: D. C. McWilliams

PROJECT MANAGER: Richard Bayley

JAN 03 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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SPECIFICATION FOR AUXILIARY TURBOMOLECULAR PUMP CARTS

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SPECIFICATION FOR AUXILIARY TURBOMOLECULAR PUMP CARTS

1.0 SCOPE

This specification covers the minimum requirements for the design, materials, fabrication, assembly, inspection, testing, preparation for shipping, and shipment of the auxiliary turbomolecular pump carts. The Vendor shall quote 1) complete packages and 2) individual components.

All attachments are 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 contract, includes two installations at widely separated sites: near Hanford, WA and Livingston, LA. Each installation 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> |
|--------------------|-----------------|-------------|
| PSI (Westboro, MA) | 2 | 4/1/96 |
| Washington Site: | 2 | 8/1/96 |
| Louisiana Site: | 2 | 8/10/97 |
| Washington Site: | 3 | 9/1/97 |
| Louisiana Site: | 1 | 3/1/98 |
| Total Required | 10 | |

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2.2 Acceptances at the sites (the start of Vendor's warranty periods) are expected to within 6 months of delivery.

3.0 EQUIPMENT REQUIREMENTS

The auxiliary turbomolecular pump carts are to be used to rough pump annular spaces between flange seals in various components. The minimum speed at the inlet port of the turbo pump shall be 50 l/s for nitrogen. (Once the annular space is roughed to, it will be maintained by an ion pump supplied by others.)

4.0 DESIGN REQUIREMENTS

4.1 Mechanical Requirements

4.1.1 Each turbomolecular pump set shall consist of a turbomolecular pump backed by an oil-free pump (diaphragm, piston or scroll pump). Also included on the carts are the accessories described below and on the attached P&ID. If a manual bypass around the TMP is necessary to permit operation from atmosphere pressure, it shall be provided by the vendor.

4.1.2 Each cart shall be a complete system mounted on a frame suitable for operation in a Federal Standard 209 Class 50,000 environment (cleanroom). Vibration isolation supports shall be included.

4.1.3 The design of the cart shall preclude contamination of the vacuum chambers during the life of the equipment, even in the event of equipment failure or operator error.

4.1.4 Deleted.

4.1.5 Provision for sealed connection to a ducted facility exhaust system shall be provided.

4.1.6 There shall be no oil in the pumping path.

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4.1.7 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 and a 1/2" quick disconnect fitting).

Filtered cooling water will be provided as follows:

| | |
|---------------------|--------------|
| Supply Temperature: | 20 - 25C |
| Supply Pressure: | 3. - 5. bara |
| Return Temperature: | 5 - 30C |
| Return Pressure: | 2. - 4. bara |

4.1.8 The process inlet to the cart shall include a flex line or bellows for connection to the roughing ports (ISO Quick Flange or Large Flange with clam shell closure, depending on the required tube size to meet the required pumping speed). Seals shall be non-lubricated baked Viton O-rings. Other connection types shall be as indicated on the attached P&ID.

4.1.9 The Buyer will supply insulated heating jackets with temperature controllers for heating the turbo pumps.

4.2 Electrical Requirements

4.2.1 Instrumentation Requirements

4.2.1.1 There shall be vacuum gauges located at each pump inlet (both the turbomolecular pump and the backing pump). The inlet to the turbomolecular pump shall have both a Pirani gauge and a cold cathode gauge, and the inlet to the backing pump shall have a Pirani gauge. Bakeable vacuum gauges are required only for the inlet (chamber side) of the turbopump (to 250°C). A local vacuum gauge readout controller shall be supplied with each cart.

4.2.1.2 There shall be auxiliary valved (manual valves) ports to allow connection of a leak detector to the inlet and outlet of the TMP.

4.2.1.3 All unused ports shall be fitted with blankoff flanges.

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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 a junction box to interface with the future LIGO control system. The following signals shall be provided:

| <u>Description</u> | <u>Signal Type</u> |
|-----------------------------|--------------------|
| Pump Running (Each Pump) | Dry Contacts |
| Auto. Valve Open | Dry Contacts |
| Roots Pump Inlet Vacuum | 0 - 10 VDC |
| Turbo Pump Inlet Vacuum (2) | 0 - 10 VDC (2) |

4.2.2.2 The pump cart shall be self-contained so that, under power failure or pump failure, interlocks shall prevent pumped volumes from being vented or from being exposed to a non-operating pump.

4.2.2.3 A manual gate valve on the chamber nozzle will be provided by others. A fail closed pneumatically actuated valve (with pilot solenoid) shall be provided on the outlet of the TMP. The controls necessary to close this valve on pump failure shall be incorporated into the cart controls.

4.2.2.4

4.2.2.5 Pumps shall be stopped and started by pushbutton switches located on the cart.

4.2.2.6 Vendor must list in his quotation all safety devices (such as flow switches, pressure switches, temperature switches, safety relief valves, etc.) supplied with the systems.

4.2.2.7 Vendor must provide in his quotation a brief description of all operational sequences such as startup, normal, operation, twist-lock, NEMA type plug configuration normal shutdown, safety shutdowns, etc.

4.2.3 Power Requirements

Power connection to the cart shall be by an appropriate 20' long cord with (a single connection for the cart, including controllers). Required controllers and overload protection shall be provided on the cart.

5.0 REQUIRED DOCUMENTATION

Documentation requirements listed in Attachment B and the Q.A. requirement form, Attachment A, shall be provided according to the Buyer's schedule.

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6.0 SHOP TESTING

In addition to the Vendor's standard tests, each electrically powered vacuum pump cart shall be tested for speed, acoustic noise, ultimate pressure, leakage and operation of protective features. All safety interlocks shall be tested for proper operation by simulating the faulted condition.

7.0 INSPECTION

All testing and inspections called for in Attachment B (Specification V049-2-033, General Equipment Requirements) shall be performed by the Vendor. Additional quality assurance requirements are listed in Attachment A, Quality Assurance Requirements Summary.

8.0 WARRANTY

Refer to Specification V049-2-034, Equipment Purchase Commercial Requirements for Warranty Requirements.

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