



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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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-ES60004-02-V
- ② LIG0-ES60005-03-V
- ③ LIG0-ES60006-02-V
- ④ LIG0-ES60007-02-V

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Title: SPECIFICATION FOR ROUGHING PUMP CARTS

SPECIFICATION FOR
ROUGHING PUMP CARTS
FOR
LIGO VACUUM EQUIPMENT

Hanford, Washington
and
Livingston, Louisiana

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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.

REV LTR.	BY-DATE	APPD. DATE	DESCRIPTION OF CHANGE
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1	SM 11/9/95	D. Williams 11-10-95	REVISED PER CLIENT COMMENTS DEO 0015
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PROCESS SYSTEMS INTERNATIONAL, INC.				SPECIFICATION		
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SPECIFICATION FOR ROUGHING PUMP CARTS

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1.0 SCOPE

This specification covers the minimum requirements for the design, materials, fabrication, assembly, inspection, testing, preparation for shipping, and shipment of roughing pump carts. Separate carts shall be provided for the roots-type pump and for the backing pump.

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 long 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 (for pairs of carts) shall be as follows:

	<u>Quantity</u>	<u>Date</u>
Washington Site:	2	8/1/96
Louisiana Site:	2	8/10/97
Total Required	4	

2.3 Acceptances at the sites (the start of Vendor's warranty periods) are expected to occur on a staggered basis, with final acceptance to occur no later than 6 months after delivery.

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3.0 EQUIPMENT REQUIREMENTS

3.1 Each pump cart (set) shall be capable of roughing down a volume of 2,000 cubic meters from 760 torr to 1 torr without overheating.

3.2 Deleted.

3.3 The minimum required pumping speed at the pump inlet at 1 torr is 500 cfm; at 0.1 torr the minimum required pumping speed is 1000 cfm. The pump set shall be capable of roughing a volume of 200 cubic meters from atmosphere to 1 torr in 4 hours or less.

3.4 Vendor to specify system performance when cart is separated (see paragraph 4.1.1).

4.0 DESIGN REQUIREMENTS

The pumpcarts will be required to operate under two distinct operating conditions: Beam Tube evacuation and Vacuum Equipment evacuation.

1. Beam Tube Pumping

The main roughing pumps will be used to evacuate the 2000 m³ beam tubes. For this case all of the roughing pump components will be mounted at a single location. It is the intent of this specification to allow this cart configuration to be the suppliers standard design.

The beam tube evacuation will occur during initial stages of construction prior to completion of the Vacuum Equipment Building. During this phase, a temporary structure will house the pumping cart system. The pumping carts will be located on the Beam Tube Anchor Foundation (see Attachment D).

2. Vacuum Equipment Pumping

For evacuating Vacuum Equipment during installation and maintenance, the pumping carts will be separated into two sections. The first stage blower will be close coupled to the Vacuum Equipment in the Vacuum Equipment room. The first stage pumps will discharge into a vacuum header connected to the second stage blower and backing pumps which will be located in a separate Mechanical Equipment Room (to minimize noise and eliminate the requirement for supplying large quantities of cooling water into the Vacuum Equipment Room). The vacuum equipment support structure for the final configuration of the first stage blower will be provided by PSI.

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4.1 Mechanical Requirements

- 4.1.1 Each cart set shall consist of a roots-type blower cart backed by one or more mechanical pumps on a separate cart, and accessories described below and on the attached P&ID Bypass valves shall be provided if required by the vendors design.. Initial operation will require the blower cart to be mounted on top of the backing pump cart. Future operation (vacuum equipment pumping) will have the blower and backing pumps separated via the following vacuum header: 150' of 6" diameter pipe, (6) 90 degree elbows, (1) 45^o elbow, (1) Tee (branch), 5' of 4" flex hose between blower discharge and header.
- 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 carts 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 The process inlet to the cart shall be supplied by others. Seals shall be non-lubricated baked Viton O-rings.
- 4.1.5 The process outlet from the roots-type pump cart shall incorporate a 10' long flex line for connection to a vacuum header (removable for beam tube pumping mode. This connection shall, depending on the required tube size, be an ISO Quick Flange or Large Flange with double claw clamps. Seals shall be non-lubricated baked Viton O-rings.
- 4.1.6 Provision for sealed connection to a ducted facility exhaust system shall be provided on the backing pump outlet.
- 4.1.7 There shall be no oil in the pumping path.
- 4.1.8 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:	25 - 30C
Return Pressure:	2. - 4. bara

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4.1.9 The roots pump cart inlet nozzle shall be in the vertical plane. A blind flange with a gauge connection and suitable volume for shop speed testing shall be provided.

4.1.10 The acoustic noise and vibration requirement detailed in Section 5.1 of Attachment A do not apply to the roughing pump carts.

4.2 Electrical Requirements

4.2.1 Instrumentation Requirements

4.2.1.1 There shall be Pirani vacuum gauges located at each pump inlet (both the roots pump and the backing pump). Bakeable vacuum gauges are required only for the inlet (chamber side) of the roots blower. A local vacuum gauge readout controller shall be provided with each cart.

4.2.1.2 There shall be auxiliary valved (manual valves) ports to allow connection of a leak detector.

4.2.1.3 All unused ports shall be fitted with blankoff flanges.

4.2.1.4 A purge gas flow switch (or pressure switch) shall be provided to shutdown the cart when there is insufficient purge gas flow (or pressure). An adjustable 10-60 second delay timer shall be included in the shutdown logic to prevent spurious shutdowns.

4.2.2 Controls Requirements

4.2.2.1 Controls for local operation shall be provided. The Buyer will interconnect the cart wiring when they are installed in the split location for Vacuum Equipment pumping (terminals to be provided by the vendor). In addition, provide terminal strips in a junction box to interface with the future LIGO control system. The following signals shall be provided:

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<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
Backing Pump Vacuum	0 - 10 VDC
Purge Gas Shutdown	Dry Contacts

4.2.2.2 The pump carts shall be self-contained so that, under power failure or pump failure, interlocks shall prevent pumped chambers 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 and open and closed limit switches) shall be provided on the outlet of the roots pump cart. The controls necessary to close this valve on pump failure shall be incorporated into the cart controls. The cart shall contain an air supply volume (with charge valve and pressure gage) of sufficient capacity to operate the valve and maintain operation for 8 hours.

4.2.2.4

4.2.2.5 Pumps shall be stopped and started by pushbutton switches located on the blower cart. The backing cart shall be capable of being started and stopped by a signal from the blower 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 quotation, normal shutdown, safety shutdowns, etc.

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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, 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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