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TELESCOPE AND SENSOR INTERFACE PRELIMINARY REQUIREMENTS REPORT FOR THE PORTS CHAMBER

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SECTION 1.0
INTRODUCTION

This report describes the interface requirements between the PORTS chamber and the LATS telescope or sensor. We have conceptually designed a LATS interface chamber which provides the mechanical interface needed between the LATS sensor and the PORTS chamber. The LATS interface provides alignment of the LATS sensor with the PORTS optical center line and then translates the sensor into the cryogenically cooled optical bench for testing Also, the interface chamber allows the LATS sensor to be accessed without breaking the PORTS chamber vacuum.

The LATS sensor measures 15" × 9.5" × 6.5" and weighs approximately 25 lbs with an estimated mass moment of inertia of 300-500 lb-in^2 (figure 1). The optical beam enters the LATS sensor through a 4.20" diameter baffled opening. Under test configuration the LATS sensor will be placed in a high vacuum cryogenic environment inside of the PORTS chamber. While under test the LATS sensor will be cryogenically cooled and thermally isolated from the rest of the PORTS chamber.

A schedule for the detailed design and fabrication of the sensor interface is shown in figure 2. This schedule is based upon performing a telescope test on MIGHTY UNCLE.

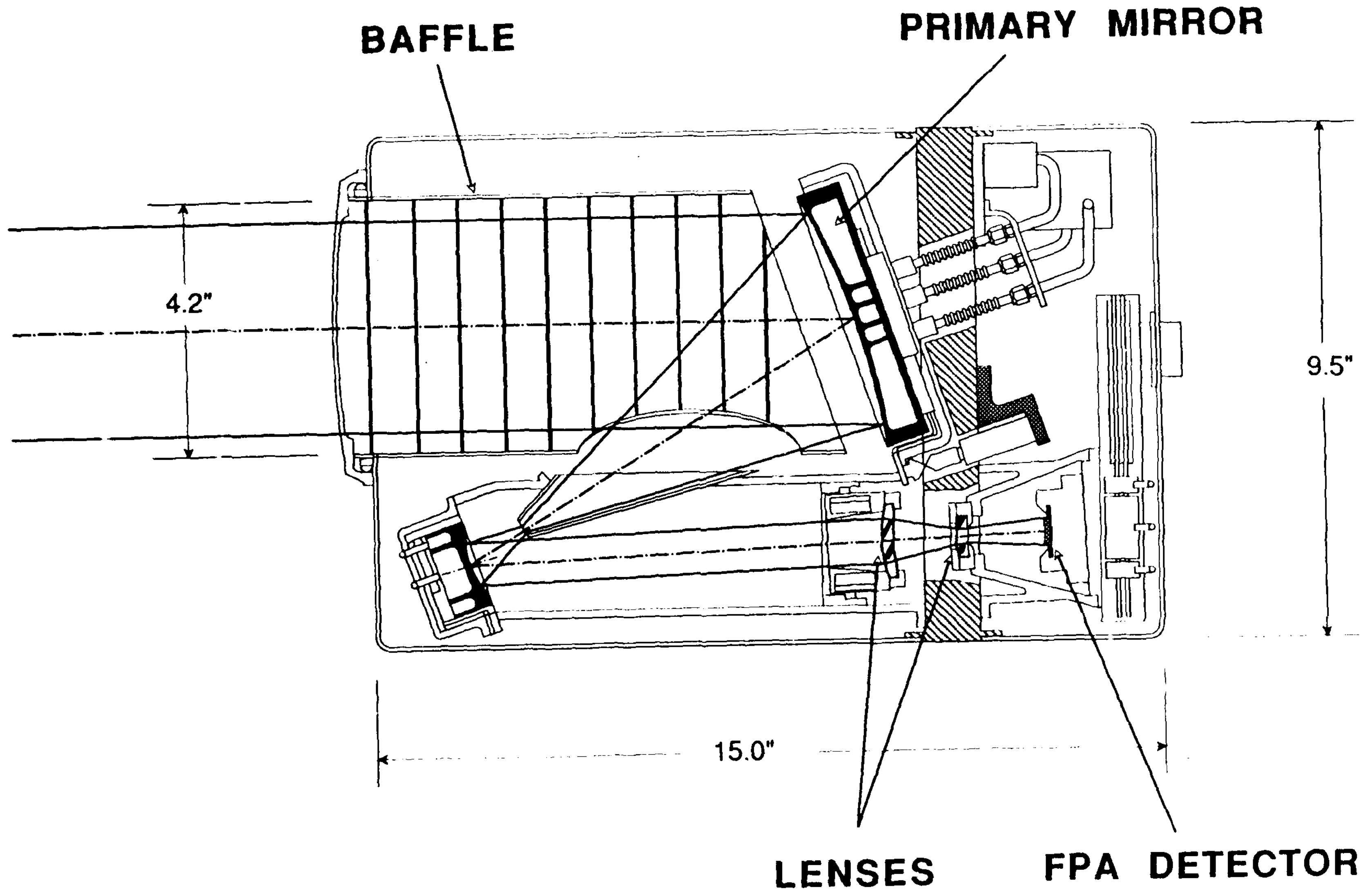

Figure 1. LATS sensor.

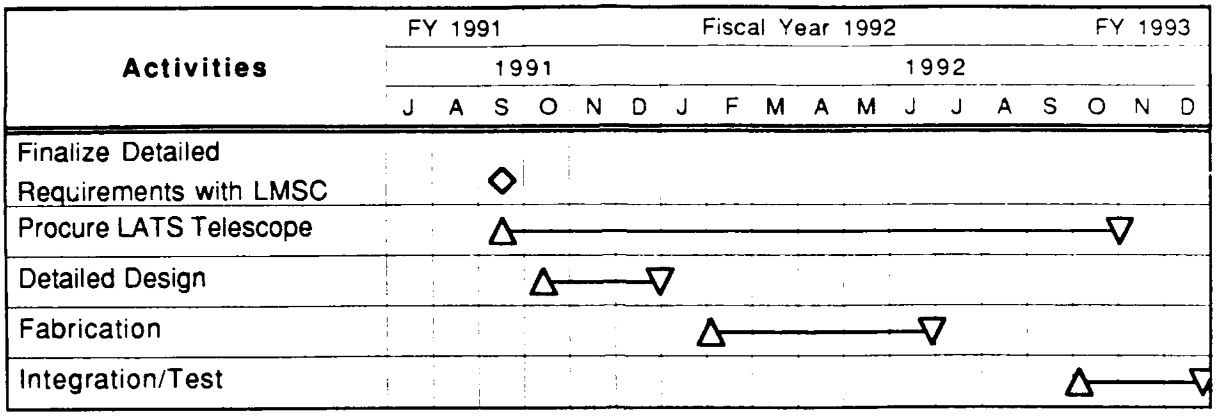

Figure 2. Telescope/sensor interface development activities.

SECTION 2.0
DESIGN REQUIREMENTS

2.1 SHOCK AND VIBRATION.

When in the test position, the LATS sensor must have a maximum deflection of less than 50 µrad with respect to the PORTS optical axis under the input shock spectrum of figure 3. The LATS sensor interface mounting structure must have a mechanical resonant frequency greater than 40 Hz.

2.2 POSITIONAL REQUIREMENTS.

The LATS interface must insert and remove the LATS sensor to and from the optical bench, as well as provide access to the sensor without breaking vacuum to the PORTS chamber. An optically tight seal must be made between the LATS sensor and the optical bench when in the test position to avoid stray light from entering the optical bench. The LATS interface must provide an adjustable mounting structure for the sensor to allow the sensor to be aligned to the optical center line of the PORTS chamber. Finally, the ante chamber must be capable of translating the LATS sensor a minimum of 36 inches inward along the PORTS optical center line with a locational repeatability of ± 1 mrad.

2.3 OPERATING TEMPERATURE.

The LATS interface must be capable of cryogenically cooling the LATS sensor as well as thermally isolating the LATS sensor from the rest of the LATS interface.

2.4 OPERATING PRESSURE.

The LATS interface must be capable of operating at pressures of 760 Torr (atmospheric pressure) to 10^{-7} Torr.

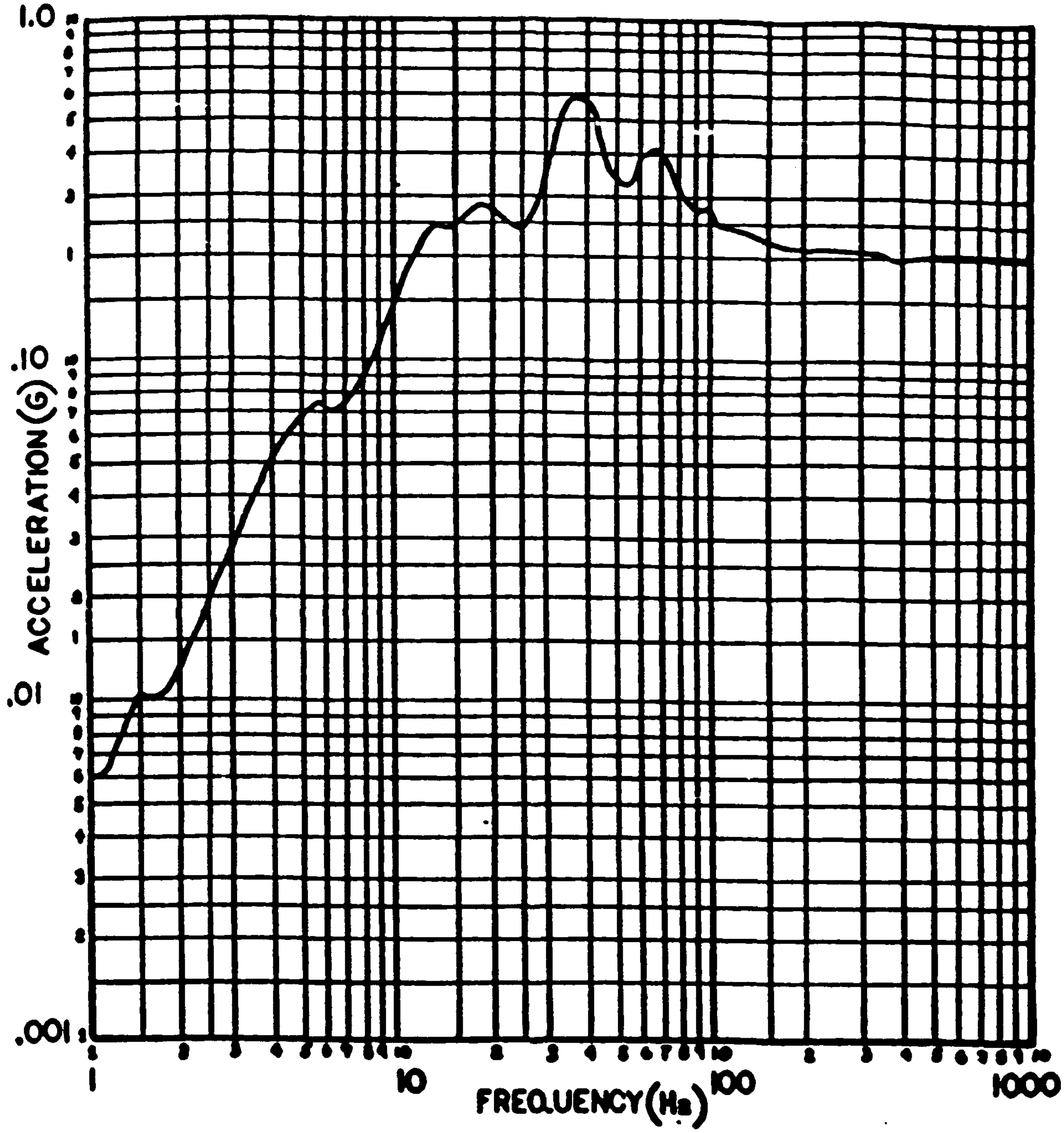

Figure 3. Operating shock spectrum. Duration = 120 msec.

SECTION 3.0
DESCRIPTION

The LATS interface chamber is an aluminum (6061-T6) cylindrical vessel 3 ft long and 20.75 inches in diameter with a wall thickness of .375 inches. The ante chamber is connected to the PORTS chamber by a 20 inch aluminum electro-pneumatic gate valve. The gate valve is located on the end cap opposite the LOS port (figure 4).

The sensor is connected to a .250 inch thick aluminum plate by the use of two angled G-10 brackets. The LATS sensor is connected to the G-10 brackets by eighteen .250-20 UNC stainless steel screws (figure 5). The G-10 angled brackets thermally isolate the LATS sensor from the rest of the chamber. The two brackets are dowel pinned and bolted using four .375-24 UNF screws to the aluminum base plate to provide locational repeatability if the sensor is removed from the chamber. The LATS sensor will be cryogenically cooled using helium gas supplied from the PORTS refrigeration system. Stainless steel, vacuum jacketed flexible hose will transfer the helium gas to the LATS sensor and allow translation of the sensor to and from the optical bench. Mounted to the bottom of the aluminum base plate are 3 pairs of linear ball bearing bushings mounted to a pair of .5 inch stainless steel linear bushing rails. Inside of the sensor port is another pair of linear bushing rails used to support the sensor as it is translated across the gate valve and into the optical bench (figure 6). When the LATS sensor is in the test configuration just out side of the optical bench, an optical baffle is used to prevent stray light from entering the optical bench (figure 7). Half of the baffle is connected to the LATS interface while the other half is connected to the optical bench end cover.

The ante chamber is connected to the PORTS chamber through three bolted interfaces. The PORTS end cap is bolted to the PORTS chamber. The gate valve is bolted on to the end cap and finally the LATS interface is bolted to the gate valve. Therefore, to assure the alignment of the LATS sensor to the PORTS optical center line an adjustable mounting structure had to be built into the LATS sensor interface. Each pair of bushing rails is connected to a two part adjustment fixture. The first fixture provides rotational adjustment about the vertical axis as well as translation perpendicular to the optical axis in the horizontal plane. The second fixture is an adjustable captive three point mounting system which allows the sensor to be rotated in the horizontal plane and translated in the vertical axis (see figure 8).

Located between the linear bushing rails in the ante chamber is a .631 inch diameter recirculating ball screw and a 24 VDC motor. The motor and ball screw are the driving force used to translate the sensor.

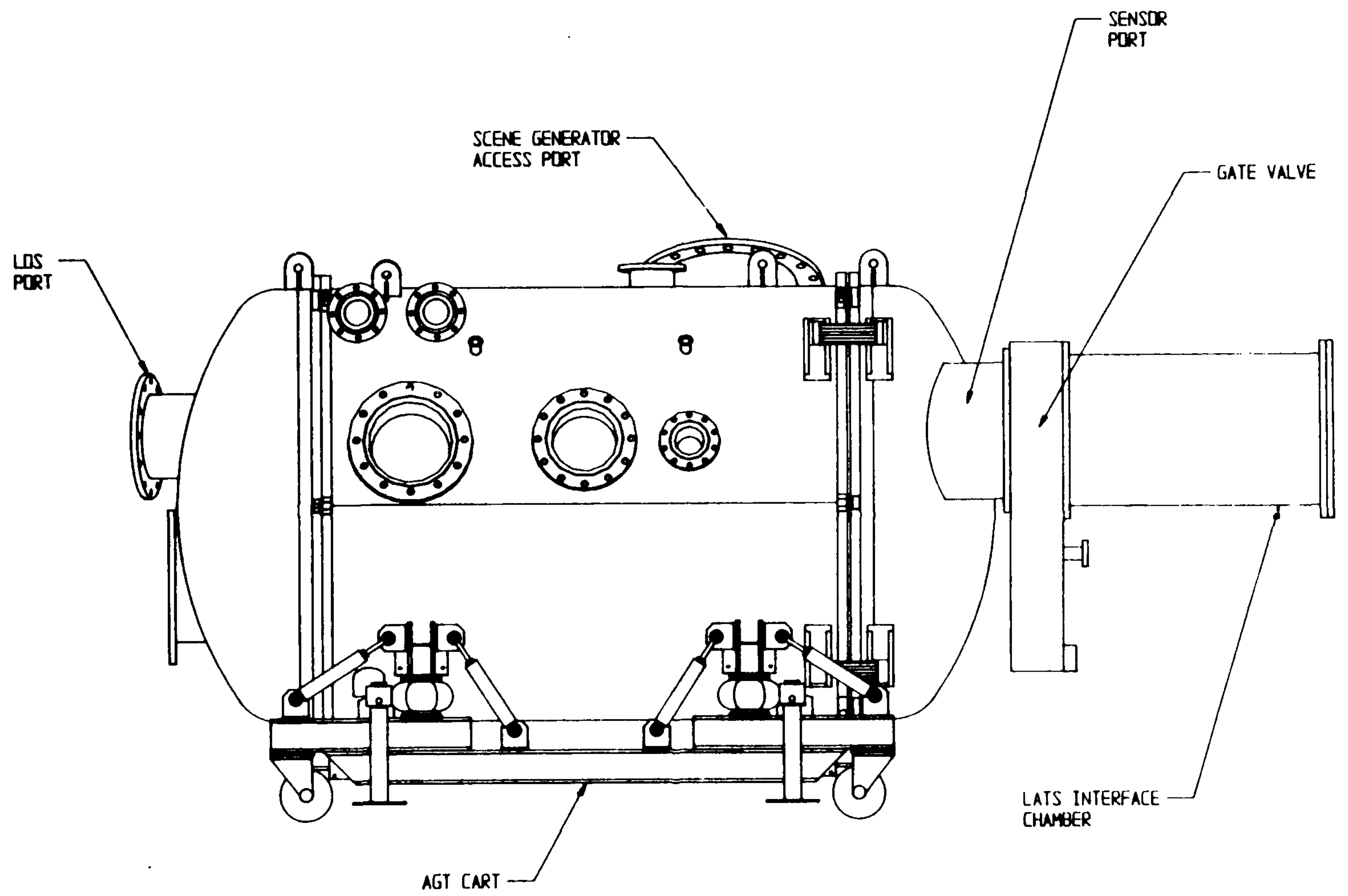

Figure 4. PORTS chamber with LATS interface chamber.

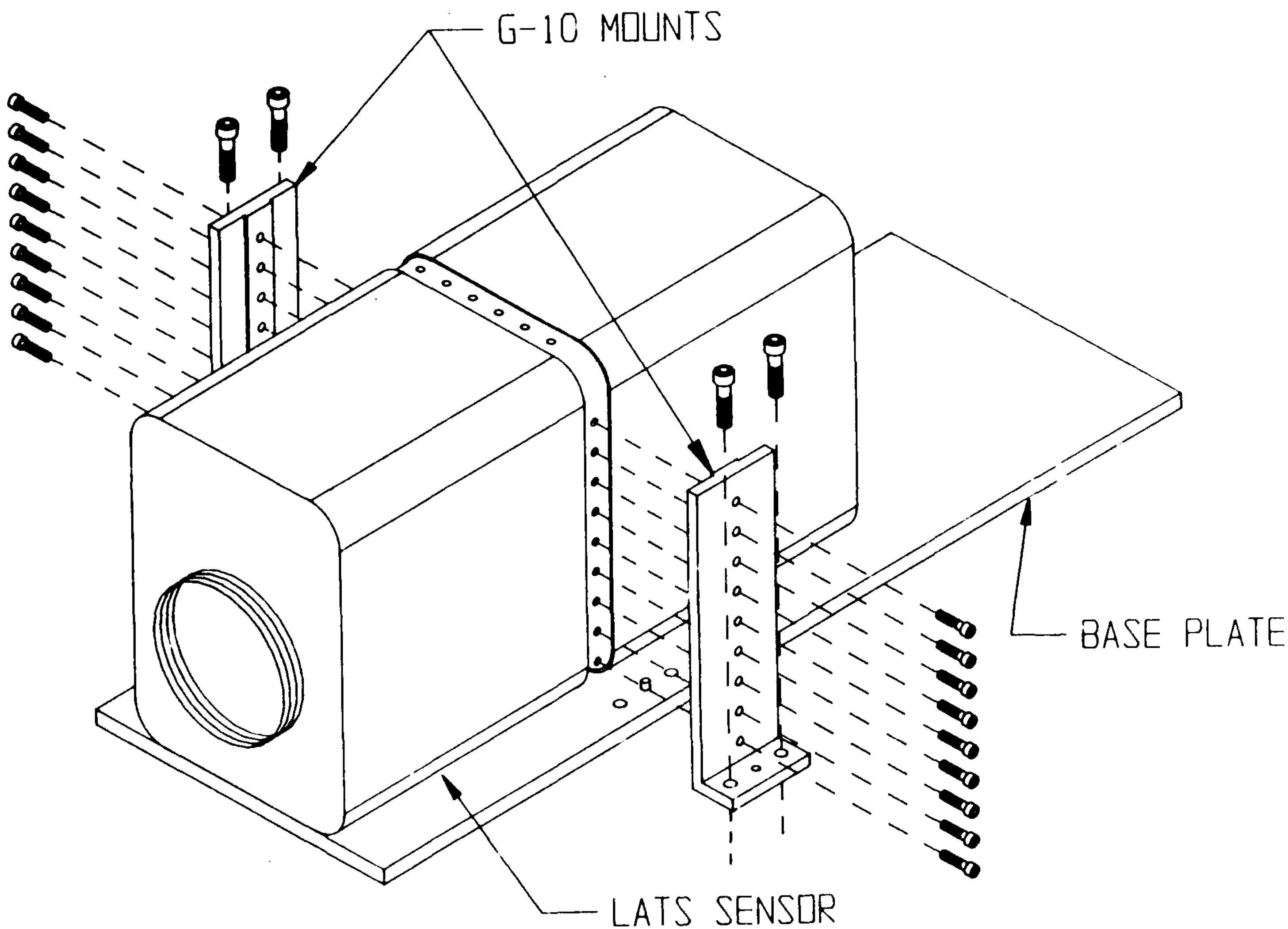

Figure 5. **LATS interface mounting hardware.**

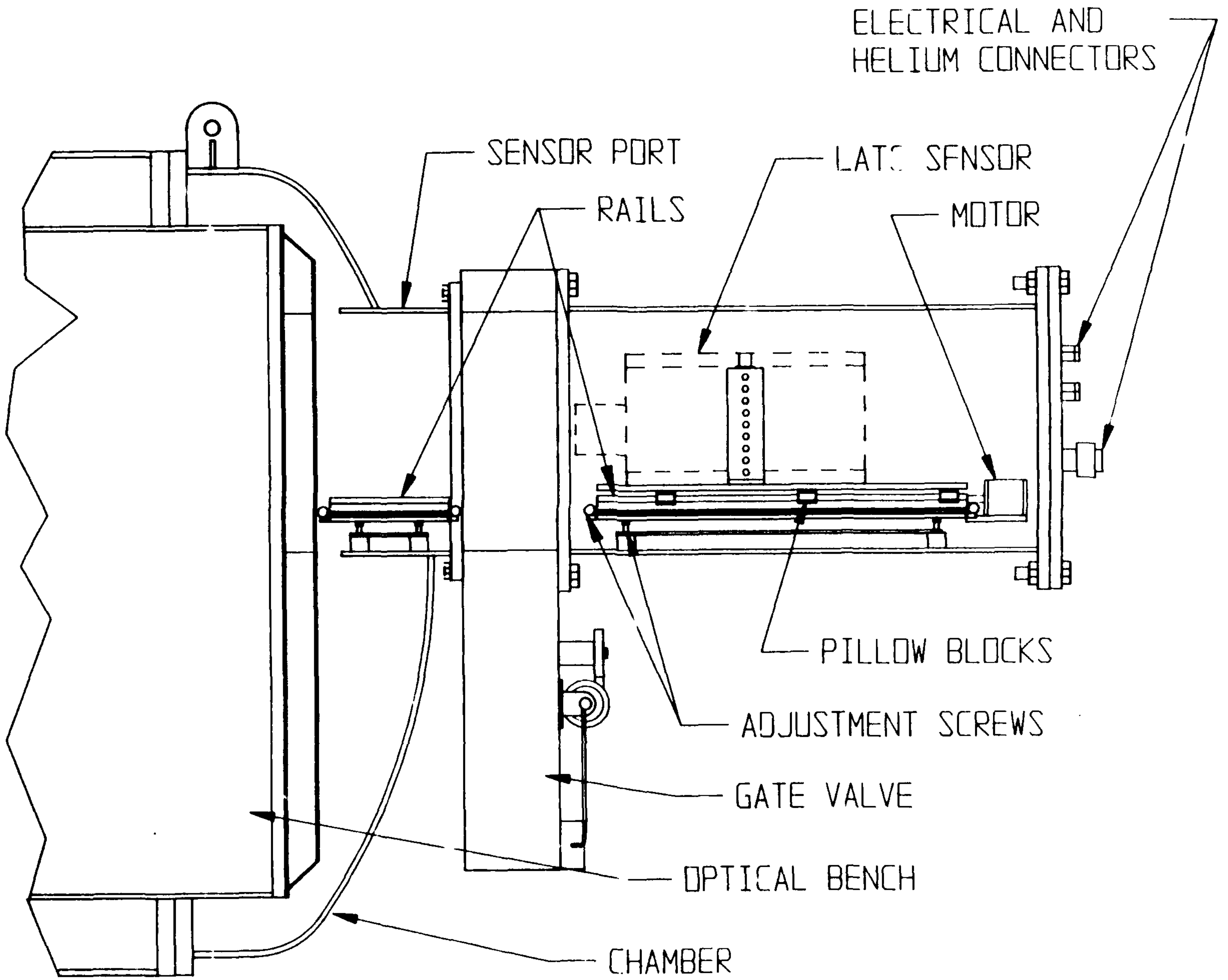

Figure 6. PORTS chamber with LATS sensor interface.

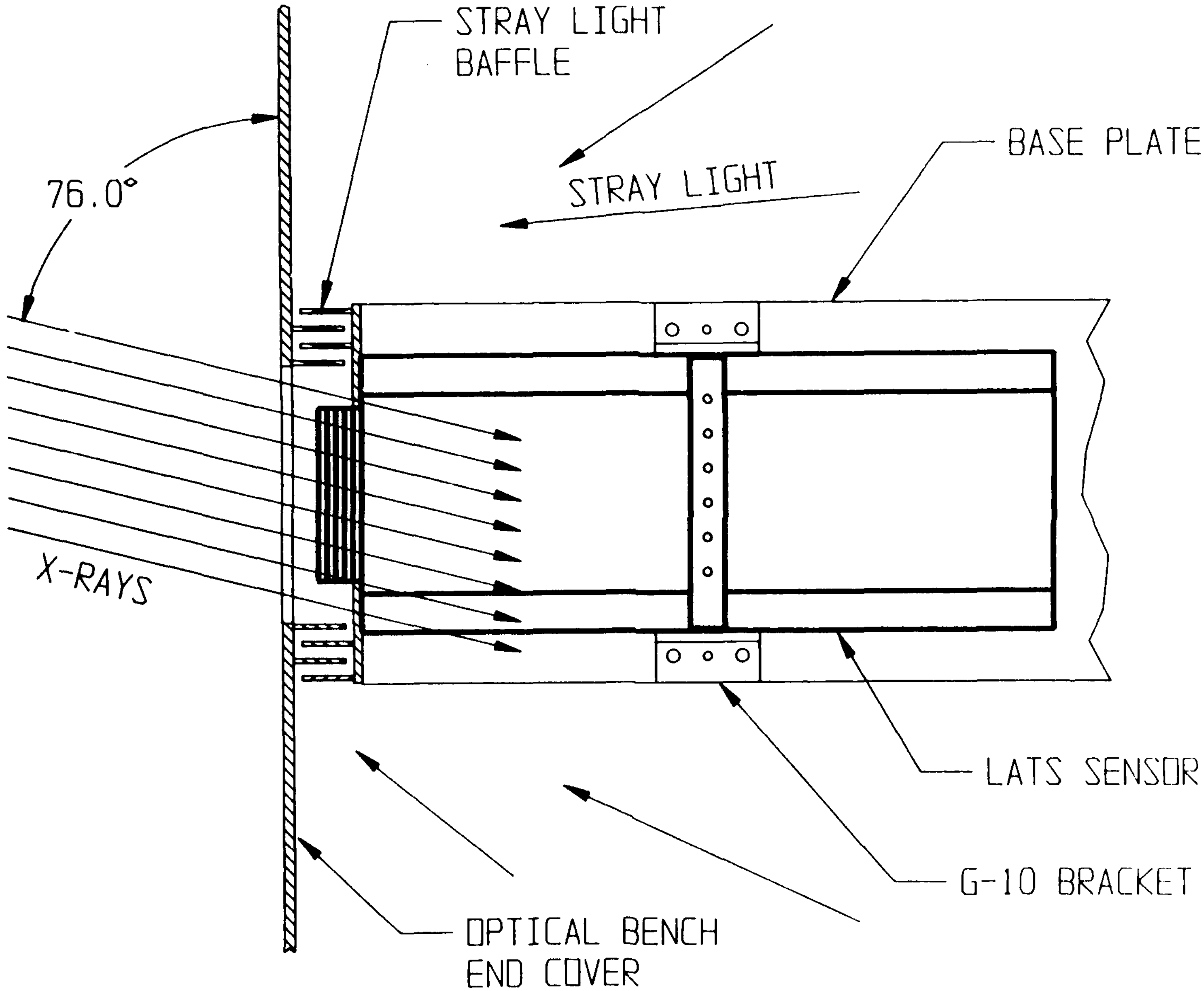

Figure 7. LATS sensor in test configuration (top view).

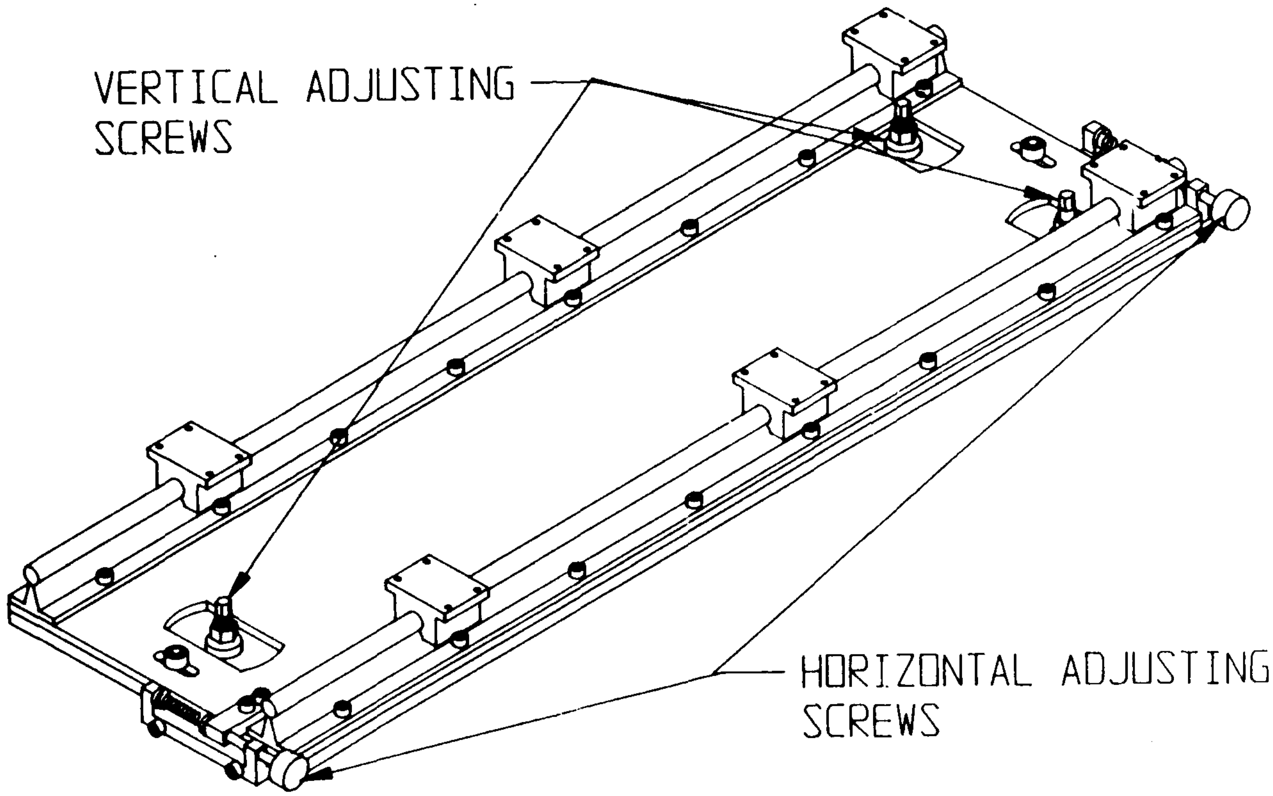

Figure 8. LATS interface adjustment platform.

SECTION 4.0
OPERATION

When the PORTS chamber is not under vacuum, the linear bushing rails in the sensor port are aligned to the PORTS chamber optical center line. This alignment can be performed either by using a set of cross hairs mounted on the sensor mounting plate or by retro-reflecting a light beam back through the PORTS optical system. After the sensor port rails have been aligned to the optical center line, the interface chamber rails are adjusted until the linear translation fixture moves freely back and forth between the two sets of linear rails. Finally, when both set of rails have been aligned, the sensor is installed and the LATS interface chamber and PORTS chamber are pumped down to 10^{-7} Torr.

A ball screw acts in a telescoping fashion to translate the sensor into the incoming radiation. A pair of rotary solenoids activate a set of latches which connect and disconnect the ball screw from the linear translation fixture, as it is translated to and from the PORTS chamber.

If the sensor ever needs to be accessed while the PORTS chamber is under vacuum, the LATS sensor can be isolated from the PORTS chamber by the gate valve. After the gate valve is closed, the LATS interface chamber can be repressurized to atmospheric pressure. When the interface chamber has been repressurized the end cover of the interface chamber can be removed to allow access to the LATS sensor.