Concepts for Viaspec Optical Mounts

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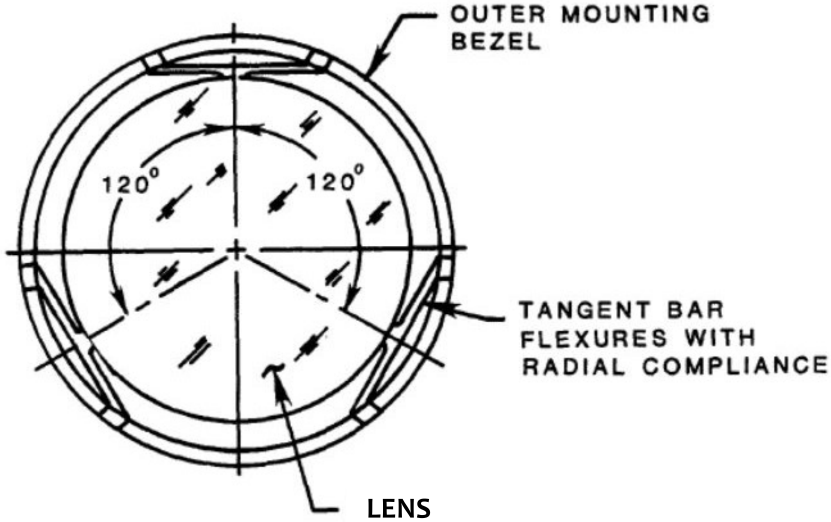
Daniel Fabricant

1 Lens Mounts

Figure 1. Three-point tangent flexure mount for Viaspec lenses. 400 series stainless steel bezels with titanium



flexures to keep radial stresses due to differential thermal expansion of lens and bezel at acceptable level. The lens would aligned to the lens bezel with an Opticentric machine.

2 Mirror Mounts

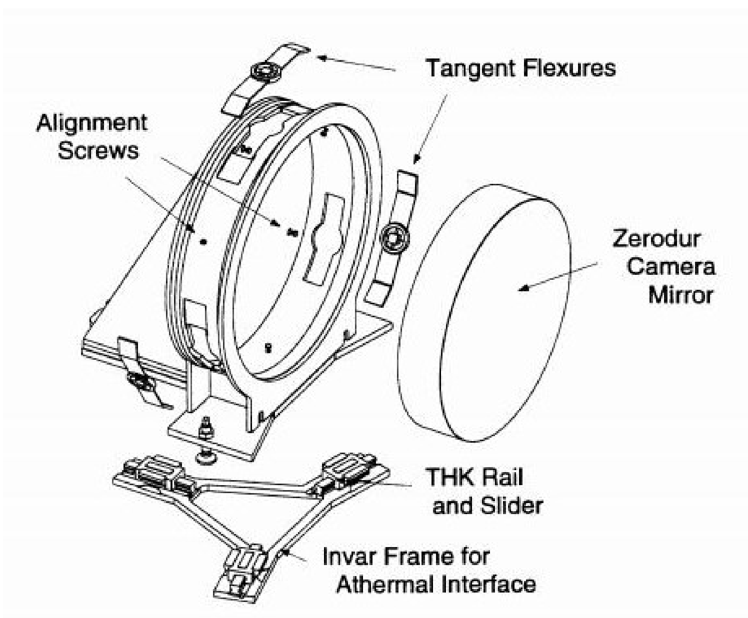


Figure 2. Mirror mounts used for the Hectospec and Hectochelle Zerodur mirrors. This style of mount would work well for the Viaspec collimator and fold mirrors. If Viaspec elects to use an optical bench with 400 series stainless steel facesheets the athermal interface would not be required.

Each Hectospec/Hectochelle style mirror mount (Figure 2) consists of three components: (1) the tangential flexures, (2) a support structure and (3) an athermal interface to accommodate the CTE mismatch between the 400-series stainless steel support structures and the Invar optical bench. The athermal interface is not required if an optical bench with 400-series stainless steel facesheets were used. We chose titanium for the flexures instead of steel because titanium's lower Young's modulus results in thicker flexures which are easier to manufacture. The titanium provides a good CTE match to the 400-series stainless steel support. A flex pivot in the flexure minimizes radial moments which may occur during assembly or operation. A small Invar mounting block or nub that will be bonded to the Zerodur mirror is press fit into the flex pivot. An Invar nub is used to minimize the stress in the epoxy layer (Hysol EA9313) between the nub and the Zerodur mirror due to the CTE mismatch.

The support structure is bolted together from machined plate stock components 6 to 18 mm thick. The flexures are designed to provide stiffness in the axial and tangential directions and to be compliant in the other four degrees of freedom. They must accommodate approximately 125 μm of (radial) differential thermal expansion between the 400-series stainless steel mount and the Zerodur mirror without introducing excessive stress. The flexures are 2.8 mm thick and 50 mm wide, providing a radial spring rate of 570 N mm^{-1}. The fundamental mode of the camera mirror and flexure system is a 200 Hz axial translation mode. The fundamental mode of the entire camera mount is a 57 Hz side-to-side rocking mode.

For assembly, the mount is rotated by 90° so that the mirror opening is facing up. The mirror is lowered into the mount until its back surface rests on three axial screws adjacent to the flexure locations. Three radial screws are also provided to align the mirror with respect to the support. Once the mirror is properly aligned with respect to the cell, the flexures are attached by bolting the ends of the flexure to the support structure and then injecting epoxy between the mirror and the Invar nub. Shims placed between the flexure and the support structure are used to achieve the desired bond thickness. After the epoxy cures, the axial and radial adjustment screws are removed.

3 Grating Mount

The mount design shown here was developed for the GMACS interchangeable gratings. The design would be adapted to mount directly on the Viaspec optical bench. The Viaspec gratings (currently 370 x 300 x 25 mm) are very similar in size to the GMACS gratings.

The gratings are mounted in bezels using the six degree of freedom mount shown in Figure 3. There are three axial flexures, one lateral flexure and two vertical flexures that preload the grating against hard points on the bezel. The grating is made from fused silica and the blank dimensions are 418 x 319 x 50 mm thick with a weight of 14.7 kg. The aluminum bezel frame has cross-sections of 30 x 54 mm (top and bottom) and 25.5 x 54 mm (sides) with a weight of 6.5 kg. The total weight of the grating/bezel assembly is ~22 kg.

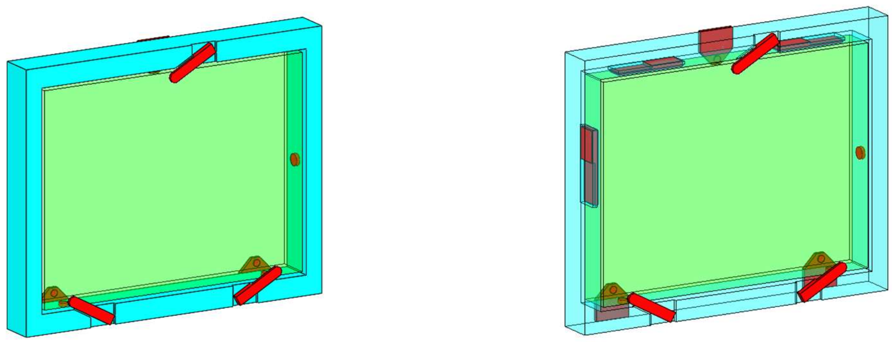


Figure 3. Solid model of the 6 DOF grating mount

The flexures were sized for a 0.5 mm enforced displacement to provide a 4.4g preload in the axial, lateral and vertical directions. Each flexure is made from Titanium 6AL-4V with a yield strength of 414 Mpa (60 ksi). The calculated flexure stress levels are ~207 Mpa (30 ksi). The flexure dimensions are shown in Table 1.

Table 1. Grating preload flexure dimensions

Flexure	Length (mm)	Width (mm)	Thickness (mm)
Axial	40.6	15.2	4.1
Lateral	46.2	30.5	2.6
Vertical	39.1	25.4	3.8

Teflon nubs are used for hard points and were sized for 5.4 g's (1g gravity plus 4.4g preload). The diameters of the axial, lateral and vertical nubs are 10.2, 17.8 and 12.7 mm, respectively. Each nub is 2.0 mm thick. The stress levels at the glass/nub interface are ~3.5 Mpa (500 psi).

4 Optical Bench

Figure 4. Commercial optical bench with hexagonal aluminum honeycomb core and ~5 mm thick 400-series stainless steel face sheets. These benches are available with a wide range of core thickness. The face sheets have ¼-20 tapped holes on 1 inch centers covering the entire top. For Viaspec we would enclose the optical bench in an insulated, temperature-controlled structure.