120” Shane Primary Cleaning

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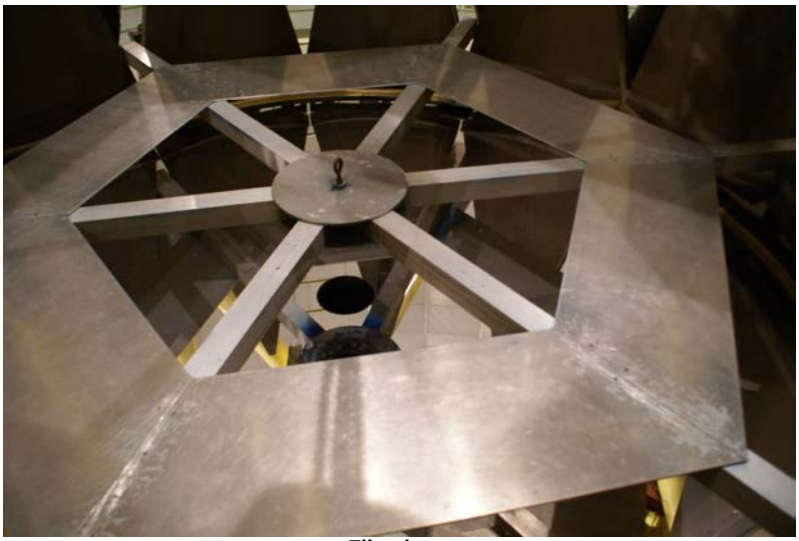
David and I cleaned the 120” primary on Friday, with the support of the Mt. Hamilton technicians. The Adaptive Optics instrumentation had to be removed before we began, as it was mounted below the telescope and we needed to attach a drain tube there.

AO Instrument Being Removed

The spider scaffold had already been positioned above the primary mirror, and the “top hat” had been removed from the mirror’s center hole.



File photo

Mirror Assessment and Reflectometry

Before cleaning we measured the reflectivity of the mirror in four field locations, roughly corresponding to the ordinal compass directions. Each measurement was made twice, using the red and the blue filters of the reflectometer. Each time a measurement was made we preceded it by calibrating the reflectometer to the reference mirror, setting it to read 100%. Thus, the measurements in the table below are expressed, not as absolute percent reflectivities, but AS COMPARED TO THE REFERENCE MIRROR.

120" Primary Mirror Before Washing

	Red	**Blue**
South	92%	90%
West	90	88
North	90	87
East	90	87

The surface of the mirror was hazy, overall, as shown in the photo below (easiest to see in the smaller of the two light spots from the flashlight). The larger spot is the reflection of the flashlight on the bottom of the scaffold.

Hazy surface in field area of primary mirror

Oil Spot Removal

There were fewer oil spots on it than there had been the last time we cleaned the mirror. We removed the oil spots with ethanol and then acetone as necessary. We squirted ethanol on each spot and then lifted off the bulk of the oil with the Kaydry, not wiping but just lifting it off. What oil was left we dabbed with more ethanol and then acetone.

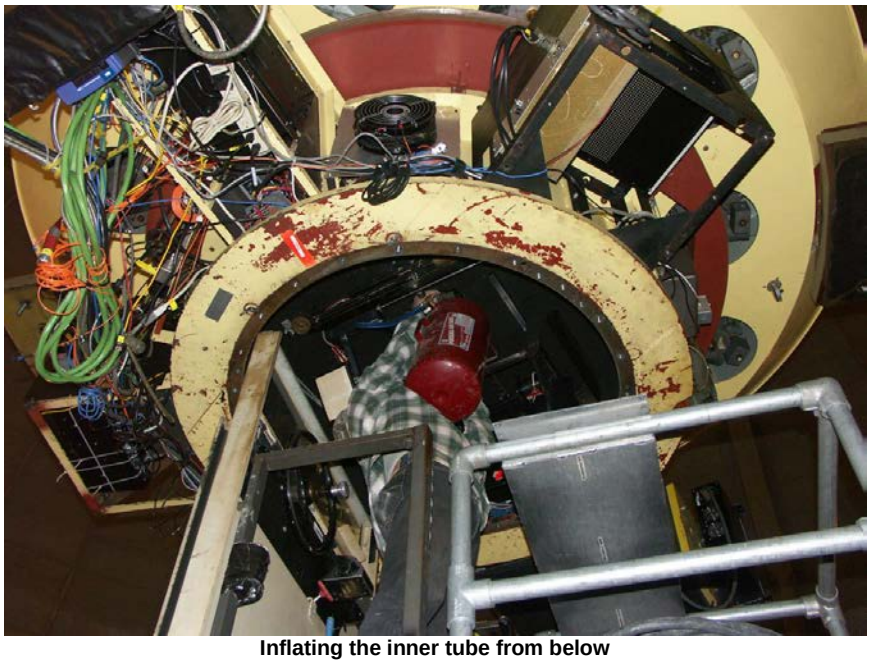
Worst of the oil spots on this trip

Dabbing oil with solvent to remove it

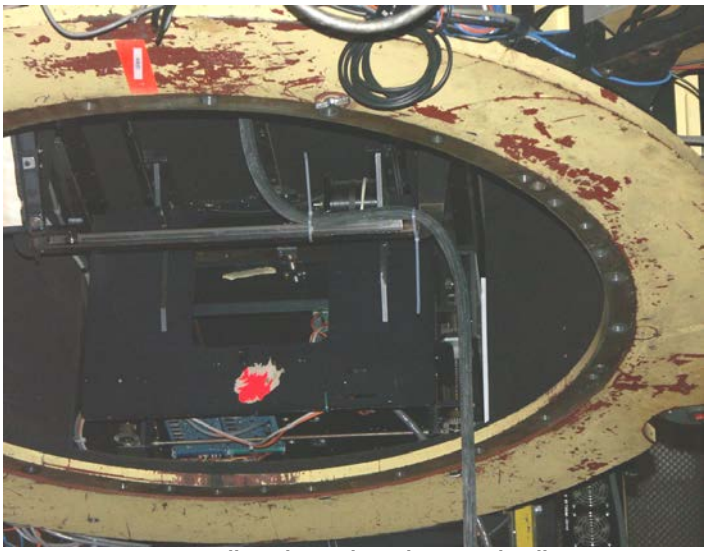
Washing

The water-catching system consisted of a 3’ length of PVC connected to a hose leading to a 55 gallon drum on the floor. The assembly is prevented from leaking by an inner-tube placed in the center hole of the mirror that gets inflated to seal around the hole. The inner-tube is attached to the PVC and the hose is attached at the bottom of that. The drain and its inner-tube seal were installed in the mirror’s center hole from beneath it, and the hose was clipped to one side to reduce the downward pull on the drain tube. On top of the mirror, Dave dumped water inside the center hole, all around the inner-tube, while people below checked to see if any water made it past the seal.

Inner tube seal for drain



Inflating the inner tube from below



Hose clipped to reduce downward pull

We brought up two buckets ½ to ¾ filled with Orvus/water and with soft natural sponges floating in them. **NOTE! We felt there was not enough Orvus compared to the amount of water and in past cleanings the buckets were not as full (more like ¼-full) so maybe the same amount of Orvus had been used with much more water. In any case, next time we should request more Orvus in the mix.** We still had three Kaydry boxes around the perimeter of the mirror structure from the oil-mopping and those tissues were used after the Orvus/water to wipe off the scaffold so it wouldn't continue to drip on the mirror.

We dabbed the wet sponges all over the mirror surface (not wiping), and we were especially careful not to let water go over the perimeter edge. There had been discussion beforehand as to whether we should wash the mirror in quadrants to prevent water from drying on the surface, but it was decided that even though the humidity in the air was low, it would have been risky to wash just a portion of the mirror at a time, so we dabbed the entire surface before blotting. It would have been difficult to control the rinse water and keep it to just the washed areas.

After the entire surface had been dabbed with Orvus we rinsed the sudsy fluid off the mirror, down the center drain. The de-ionized flushing water was supplied from a pressurized stainless-steel tank that Kostas had on the lift platform alongside the mirror. Brian kept the hose from getting tangled or touching the mirror while Dave directed the stream to wash the soap into the drain. He called for low pressure at the beginning while he rinsed all around the perimeter, and then higher pressure when he was working safely in the field area. Since the water continued to flow while the hose was moved around the scaffold, the scaffold got wet and had to be dried with Kaydrys before continuing, in order to prevent the water from dripping off onto the mirror.

We next blotted up the water using large (2' x 3') sheets of blotter paper purchased from an art supply house. Before going up to the mirror we had cut some blotter sheets into quarters, as the large ones are unwieldy and prone to leaving areas around the perimeter uncovered. They are also difficult to get below the scaffold without dragging on the mirror or touching the scaffold. The large sheets are easy to rip into smaller pieces, but doing so generates debris that stays on the mirror, so having some cut ahead of time worked out well.

From prior cleaning trip

From prior cleaning trip

This trip – Blotter paper covers mirror surface

After blotting up the water we were left with a much cleaner surface, as the representative picture below shows.

Shiny surface restored

We re-measured the reflectivity, trying to place the reflectometer in the same locations that we had used prior to cleaning. To repeat, the measurements in the table below are expressed, not as absolute percent reflectivities, but AS COMPARED TO THE REFERENCE MIRROR. Extra columns in the table below list the gains in reflectivity for each filter color.

120" Primary Mirror After Washing

	Red	**Red Gain**	**Blue**	**Blue Gain**
South	99%	7%	92%	2%
West	94	4	89	1
North	100	10	97	10
East	94	4	93	6