

# 120 INCH MIRROR WASHING REPORT

## REFLECTOMETER MEASUREMENTS OF UCO/LICK OBSERVATORY'S 3-METER PRIMARY MIRROR BEFORE AND AFTER WASHING

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On August 31, 2009, the Shane telescope's 3-meter primary mirror was scheduled for its annual washing. The mirror was previously aluminized on 2-15-06 and washed on 2-1-07 and 9-11-08. CO2 snow cleaning was regularly done on a monthly basis and had been done shortly before today's washing, with no noted visual improvement. The washing is performed with the mirror in-situ with the telescope pointed at the zenith and the Cassegrain hole in the primary's center fitted with an expandable bladder (small rubber inner tube) surrounding a large PVC pipe whose closed bottom end is fitted with a brass hose connection. An ordinary garden hose is attached to this assembly to drain the wash water to a nearby sink. The bladder is air inflated to provide a tight seal between the edge of the glass and the fixture.

Measurements were first made using Lick's shop built reflectometer. This measures in two wavelength ranges and compares the reflectivity of an over-coated aluminum witness against the unknown mirror. The Lick reflectometer results will not be discussed in this paper. NASA's SOFIA project recently purchased a reflectometer from Surface Optics Corporation that has the capability of measuring from 400 nm to 1100 nm and by interchanging the sensor head, can measure into the far IR. The unit comes with calibration samples to give an accurate reflectivity measurement of the unknown mirror. Ken Bower, Charles Kaminski with USRA and Bill Brown with Lick/USRA, participated in making measurements using the new tool. The measurements were made both before and after washing the 3-meter mirror. After first removing oil spots from the mirror surface with acetone, a mixture of Orvus soap and distilled water was used for washing, with a rinse of distilled water. Because of time constraints in order to get the telescope ready for the night's observing, we were only able to measure the reflectivity in the 400-1100 nm range.

The tool makes simultaneous measurements in four wavelength ranges and gives measurements of both specular and total reflectance. Several sets of measurements were taken, but only averages are shown below. The mathematical difference between the total reflectance and the specular reflectance is given as the amount of scattered light in percent.

### 3-METER PRIMARY BEFORE WASHING

<u>RANGE (nm)</u>	<u>SPECULAR (%)</u>	<u>TOTAL (%)</u>	<u>DELTA(scatter %)</u>
400-540	82.0	88.8	6.8
480-600	82.0	88.6	6.6
590-720	81.4	88.0	6.6
900-1100	88.0	94.2	6.2

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## 3-METER PRIMARY AFTER WASHING

400-540	86.3	89.7	3.4
480-600	86.1	89.2	3.1
590-720	85.6	88.5	2.9
900-1100	92.8	94.8	2.0

From the above, it can be seen that the soap and water washing improved the specular reflectance by about 4%, but only improved the total reflectance by less than 1%. Although much dirt was removed, the coating had degraded such that the scatter has increased after three years. A re-aluminizing will be scheduled in the first semester of next year.