



SPECIFICATION

LCGT Power Recycling Mirror 3 (PR3)

| AUTHOR: | CHECKED: | DATE | APPROVALS | | |
|---------------|----------|----------|-----------|-----|----------|
| | | | DCN NO. | REV | DATE |
| Eiichi Hirose | | Nov21-11 | | V1 | Nov21-11 |
| | | Jan31-12 | | V2 | Jan31-12 |
| | | Feb27-12 | | V3 | Feb27-12 |
| | | | | | |
| | | | | | |

Applicable Documents

- LCGT-MIR-D00006-V1 Fused Silica Substrate, LCGT PR3
- LCGT-XXXXX-A Fused Silica Blank, PR3
- LCGT-XXXXX-A Fused Silica Blank, PR3

Requirements

Physical Configuration

According to LCGT-MIR-D00006-V1 Fused Silica Substrate, LCGT PR3

Fabricate from

- LCGT-XXXXX- A Fused Silica Blank, PR3
- LCGT-XXXXX- A Fused Silica Blank, PR3

Registration Marks

Registration marks shall be etched, ground or sandblasted and located per LCGT-MIR-D00006-V1

Side and Bevel Polish

All surfaces, including Sides and Bevels shall be polished using a progression of smaller grit sizes. The last step before final polish shall be equal to or less than a five micrometer grit finish. These surfaces shall appear transparent with no grey, scuffs or scratches visible to the naked eye when viewed in normal room light against a black background.

Bevel

Bevel for safety per LCGT-MIR-D00006-V1

Clear Aperture (CA)

- Surface1: 220mm
- Surface 2: 220mm

Scratches, Sleeks and Point defects

Point defects of radius greater than 25 micrometers are treated like scratches for the purpose of this specification.

**LCGT Power Recycling Mirror 3 (PR3)****Scratches and Sleeks, Surface 1**

The total area of scratches and sleeks within the central 200 mm diameter shall not exceed 3.5×10^4 square micrometers (width times length.)

Point Defects, Surface 1

There shall be no more than 50 point defects of radius greater than 2 μm within the central 200 mm diameter.

Scratch and Point Defect Inspection Method

1. The surface is examined visually by two observers independently. The examination is done against a dark background using a fiber optic illumination system of at least 200 W total power. A 100% inspection of the surface is carried out. Pits and scratches down to 2 micrometers in width can be detected using this method of inspection. Any scratches or sleeks that are detected will be measured using a calibrated eyepiece.

2. Further inspection will be done with a minimum 6X eyeglass using the same illumination conditions, again with two observers. Sleeks down to 0.5 micrometers wide can be detected using this method. The surface will be scanned along one or two chords from centre to edge, then at ten positions around the edge, and ten to fifteen positions near the centre.

3. An inspection is then carried out with a dark or bright field microscope, with 5x objective at four positions at each of the following locations:

- Within 5mm of the center of the surface.
- Equally spaced along the circumference of a centered, 60 mm diameter circle.
- Equally spaced along the circumference of a centered, 120 mm diameter circle.

Optical Surface Figure, measured over the CA

Surface 1: Spherical, concave. Radius of curvature: 24.57 m -0.01m, +0.01 m absolute accuracy
Astigmatism: < 30 nm Amplitude of the Zernike coefficient $Z_{2,2}$

Surface 2: Nominally flat. ROC > |7000m|

Surface Error, measured over the CA**Surface1**

The following relation should be satisfied.

$$\int_{f_0}^{f_{max}} df \cdot PSD(f) \cdot L(f) + \left(\frac{4\pi}{\lambda}\right)^2 \cdot \sigma_{rms}^2|_{f>f_{max}} < 79 \text{ ppm} ,$$

where

PSD(f): Power Spectral Density measured on the surface. The unit is [$\text{nm}^2 \text{mm}$]

L(f): Loss function defined below. The unit is [ppm/nm^2]

$$\left\{ \begin{array}{l} 300 \text{ ppm}/\text{nm}^2 \text{ for } 0.125\text{mm}^{-1} < f, \text{ (or } \lambda < 8\text{mm)} \\ 500 \text{ ppm}/\text{nm}^2 \text{ for } 0.04\text{mm}^{-1} \leq f < 0.125\text{mm}^{-1}, \text{ (or } 8\text{mm} \leq \lambda < 25\text{mm)} \\ 0 \text{ ppm}/\text{nm}^2 \text{ for } f < 0.04\text{mm}^{-1}, \text{ (or } 25\text{mm} \leq \lambda) \end{array} \right.$$



LCGT Power Recycling Mirror 3 (PR3)

$\lambda : 1064\text{nm}$

$f_0 : 0.04\text{mm}^{-1}$

$f_{max} : 2.5\text{mm}^{-1}$

$\sigma_{rms}|_{f>f_{max}}$: root mean square standard deviation (σ_{rms}) value @ $f > f_{max}$

Surface2

$\sigma_{rms} < 40 \text{ nm @ } 0.04\text{mm}^{-1} < f < 1\text{mm}^{-1}$

Inspection

Table 1: Inspections

| Specification | Test Method and frequency | Data Delivered |
|--|---------------------------|--|
| Dimensions | Measurement 100% | Measurement Results |
| Scratches and Point defects methods 1 and 2 | Visual Inspection 100% | Hand sketch including scratch/pit dimensions |
| Scratches and Point defects method 3 | Visual Inspection 100% | Digital image of each inspection location |
| Figure | Interferometry 100% | Surface phase maps |
| Errors - Low Spatial Frequency | Interferometry 100% | Surface phase maps |
| Errors - High Spatial Frequency | Interferometry 100% | Surface maps for 3 central locations. Numerical values included with certification |

Orientation: For the purpose of full surface phase maps the data shall be oriented such that the substrate registration mark is at the top center of the data.

Format: All Data shall be delivered according to Table 1. In addition to the hard copy, an electronic data set of the phase maps shall be delivered in ASCII format.