



SPECIFICATION

LCGT Signal Recycling Mirror (SRM)

| AUTHOR: | CHECKED: | DATE | APPROVALS | | |
|-----------|----------|----------|-----------|-----|----------|
| | | | DCN NO. | REV | DATE |
| E. Hirose | | Nov21-11 | | V1 | Nov21-11 |
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Applicable Documents

- LCGT-MIR-D00007-V1 Fused Silica Substrate, LCGT Signal Recycling Mirror
- LCGT-XXXXX-A Fused Silica Blank, Signal Recycling Mirror
- LCGT-XXXXX-A Fused Silica Blank, Signal Recycling Mirror

Requirements

Physical Configuration

According to LCGT-MIR-D00007-V1 Fused Silica Substrate, LCGT Signal Recycling Mirror

Fabricate from

- LCGT-XXXXX- A Fused Silica Blank, Signal Recycling Mirror
- LCGT-XXXXX- A Fused Silica Blank, Signal Recycling Mirror

Registration Marks

Registration marks shall be etched, ground or sandblasted and located per LCGT-MIR-D00007-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-D00007-V1

Serial Number

Serial Number “SRM YY” shall be shall be etched, ground or sandblasted on the barrel of the optic per LCGT-MIR-D00007-V1, where Y is incremental starting with 01.

Witness Samples:

Vendor will deliver two 2-inch witness samples according to requirements on page 4 of this specification



LCGT Signal Recycling Mirror (SRM)

Scratches, Sleeks and Point defects

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

Scratches and Sleeks, Surface 1

There shall be no scratches and sleeks within the central 15mm diameter.

The total area of scratches and sleeks within the central 30 mm diameter shall not exceed 400 square micrometers (width times length.)

The total area of scratches and sleeks outside the central 30 mm diameter shall not exceed 23×10^4 square micrometers (width times length.)

Scratches and Sleeks, Surface 2

The total area of scratches and sleeks within the central 15 mm diameter shall not exceed 400 square micrometers (width times length.)

The total area of scratches and sleeks within the central 30 mm diameter shall not exceed 53×10^2 square micrometers (width times length.)

Point Defects, Surface 1

There shall be no point defects of radius greater than $2 \mu\text{m}$ within the central 15 mm diameter.

There shall be no more than 1 point defect of radius greater than $2 \mu\text{m}$ within the central 30mm diameter.

Average density of defects less than $2 \mu\text{m}$ radius within the central 30mm diameter shall be no more than or equal to 1 per 4mm^2

Point Defects, Surface 2

There shall be no more than 1 point defect of radius greater than $2 \mu\text{m}$ within the central 15 mm diameter.

There shall be no more than 9 point defects of radius greater than $2 \mu\text{m}$ within the central 30 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, 10 mm diameter circle.

**LCGT Signal Recycling Mirror (SRM)****Optical Surface Figure, measured over the central 160 mm diameter**

Surface 1: Spherical, convex. Radius of curvature: 303.96 m -1.50m, +1.50 m absolute accuracy

Astigmatism: < 15 nm Amplitude of the Zernike coefficient $Z_{2,2}$ as defined in Born and Wolf pp. 523-525.

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

Surface Error, Low Spatial Frequency: measurement aperture to 1 mm⁻¹

The following root mean square standard deviation (σ_{rms}) values are calculated from the phase maps which are to be provided with each optic. For this calculation the amplitudes for the best fit Zernike terms $Z_{0,0}$, $Z_{1,1}$, $Z_{2,0}$ and $Z_{2,2}$ or corresponding Seidel aberrations are subtracted from the phase map. Known bad pixels may be excluded from this calculation.

Surface 1 and 2, Frequency Band: < 1 mm⁻¹

Measured outside the central 10 mm diameter aperture: $\sigma_{\text{rms}} < 0.5$ nanometers

Measured over the central 30 mm diameter aperture: $\sigma_{\text{rms}} < 1.0$ nanometers

Error, High Spatial Frequency: 1– 750 mm⁻¹

Surface 1 HSF error $\sigma_{\text{rms}} \leq 0.3$ nanometers

measured at the following locations:

1. Within 2mm of the center of the surface.
2. Four positions equally spaced along the circumference of a centered, 10 mm diameter circle.
3. Three positions equally spaced along the circumference of a centered, 20 mm diameter circle.

**LCGT Signal Recycling Mirror (SRM)****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.