LCGT Power Recycling Mirror 2 (PR2)

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			DCN NO.	REV	DATE
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Applicable Documents

LCGT-MIR-D00005-V1   Fused Silica Substrate, LCGT PR2
LCGT-XXXXX-A   Fused Silica Blank, PR2

Requirements

Physical Configuration

According to LCGT-MIR-D00005-V1   Fused Silica Substrate, LCGT PR2

Fabricate from

LCGT-XXXXX- A   Fused Silica Blank, PR2

Registration Marks

Registration marks shall be etched, ground or sandblasted and located per LCGT-MIR-D00005-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-D00005-V1

Clear Aperture (CA)

Surface1: 40mm

Surface 2: 40mm

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 450 square micrometers (width times length.)

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LARGE-SCALE CRYOGENIC GRAVITATIONAL-WAVE TELESCOPE

SPECIFICATION

- V3 -D

Drawing No   Rev. Group

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Point Defects, Surface 1

There shall be no point defects of radius greater than 2 μm within the central 15 mm diameter.

Average density of defects less than 2 μm radius within the central 30mm diameter shall be no more than or equal to 1 per 4mm^2

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:

   a) Within 5mm of the center of the surface.

   b) Equally spaced along the circumference of a centered, 20 mm diameter circle.

Optical Surface Figure, measured over the CA

Surface 1: Spherical, convex. Radius of curvature: 2.763 m -0.010m, +0.010 m absolute accuracy
Astigmatism: < 8 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.

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

where

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

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

$$\left[\begin{array}{l} 400 \, ppm/nm^2 \; for \; 0.5mm^{-1} < f, \; (or \; \lambda < 2mm) \\ 500 \, ppm/nm^2 \; for \; 0.2mm^{-1} \leq f < 0.5mm^{-1}, \; (or \; 2mm \leq \lambda < 5mm) \\ 0 \, ppm/nm^2 \; for \; f < 0.2mm^{-1}, \; (or \; 5mm \leq \lambda) \end{array}\right.$$

λ : 1064nm

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$f_0 : 0.2mm^{-1}$

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

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

Surface2

$\sigma_{rms} < 40$ nm @ $0.2mm^{-1} < f < 1mm^{-1}$

$\sigma_{rms} \leq 0.4$ nm @ $1mm^{-1} < f$

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.

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