



**SUBSTRATE, ALIGO INPUT MODE CLEANER CURVED MIRROR (F-IMCC) for H2 interferometer - folded**

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			DCN NO.	REV	DATE
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**Applicable Documents**

- D080740-A-D ALIGO Folded Input Mode Cleaner Curved Mirror Substrate
- D070084-A-D ALIGO Input Mode Cleaner Curved Mirror, Blank
- E070072-A-D Mirror Blank Material, ALIGO Input Mode Cleaner Curved Mirror (IMCC)

**Requirements**

**Physical Configuration**

Fabricate from D080740-A-D ALIGO Folded Input Mode Cleaner Curved Mirror Substrate  
Arrow indicates Surface 1, the highly reflective surface.

**Serial Number**

The Serial number shall be of the format:  
F-IMCC-YY-Z Where  
YY is incremental for each optic starting at 01.  
Z is the current revision letter of this specification.

**Registration Marks**

Registration mark and Serial Numbers shall be etched, ground or sandblasted as specified in D080740-A-D ALIGO Folded Input Mode Cleaner Curved Mirror Substrate.

**Side and Bevel Polish**

Sides and Bevels shall be polished from a 5 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.

**Wedge angle**

Specified according to drawing D080740-A-D, ALIGO Folded Input Mode Cleaner Curved Mirror Substrate



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### **Scratches 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 15 mm diameter

The total area of scratches and sleeks within the central 40 mm diameter shall not exceed  $6 \times 10^2$  square micrometers, width times length.

The total area of scratches and sleeks outside the central 40 mm diameter shall not exceed  $25 \times 10^3$  square micrometers.

#### **Point Defects, Surface 1:**

There shall be no point defects of radius greater than 2 micrometers within central 40 mm. Average density of defects less than 2 micrometers radius within the central 40 mm diameter must be less than or equal with 1 per  $4 \text{ mm}^2$ . Point defects of radius less than 2 micrometers are disregarded outside the central 40 mm.

There shall be no more than 60 point defects of radius greater than 2 micrometers on the entire surface.

#### **Scratches and Sleeks, Surface 2**

The total area of scratches and sleeks within the central 40 mm diameter shall not exceed  $25 \times 10^2$  square micrometers, width times length.

The total area of scratches outside the central 40 mm diameter shall not exceed  $50 \times 10^3$  square micrometers.

#### **Point Defects, Surface 2**

There shall be no more than 120 point defects of radius greater than 2 micrometers on the entire surface.

Point defects of radius less than 2 micrometers are disregarded.

### **Inspection Method**

1. The surface is examined visually by two observers independently. The examination is done against a dark background using a three-bundle fiber optic illumination system of 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 that are detected will be measured using a calibrated eyepiece.
2. Further inspection shall be done with a 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 center to edge, then at ten positions around the edge, and ten to fifteen positions near the center.
3. An inspection is then carried out with a dark field microscope with a similar sampling frequency as described in section 2.



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### **Surface Figure, measured over the central 80 mm diameter**

All specified quantities refer to the physical surface of the optics.

#### **Surface 1: Spherical, concave**

Radius of curvature requirement: 28.54 meters  $\pm$  0.14 meters. Radius of curvature goal: 28.54 meters  $\pm$  0.03 meters

Astigmatism: < 20 nanometers (surface peak to valley)

#### **Surface 2: Flat**

Radius of curvature: > 10 kilometers

Astigmatism: < 50 nanometers (surface peak to valley)

### **Surface Errors**

All specified quantities refer to the physical surface of the optics.

The following root mean square standard deviation ( $\sigma_{\text{rms}}$ ) values are calculated from the phase maps which are to be provided with each optics.  $\sigma_{\text{rms}}$  is defined as the square root of the mean of the square of each pixel value. Known bad pixels are excluded from this calculation. The calculation assumes a wavelength of 632.8 nanometer wavelength source.

#### **Aberrations, Surface 1:**

With piston, tip, tilt, power (best fit spherical surface) and astigmatism removed over the central 80 mm diameter aperture:

RMS deviation from flatness < 1/200 wave

#### **Microroughness, Surface 1:**

Required:  $\sigma_{\text{rms}}$  < 0.1 nanometers. Goal  $\sigma_{\text{rms}}$  < 0.05 nanometers

Measured at the following locations:

1. The center of the mirror substrate
2. Four positions equally spaced along the circumference of centered 20 mm diameter circle.
3. Three positions equally spaced along the circumference of centered 40 mm diameter circle

#### **Aberrations, Surface 2:**

With piston, tip, tilt, power (best fit spherical surface) and astigmatism removed over the central 80 mm diameter aperture:

RMS deviation from flatness < 1/20 wave

#### **Microroughness, Surface 2:**

$\sigma_{\text{rms}}$  < 0.4 nanometers

Measured at the center of the mirror substrate.

**Table 1.**

Specification	Test Method	Frequency of Inspection	Data Delivered
Physical Dimensions	Measurement	100%	Diameter, Thickness, Bevel dimension, Wedge angle.
Side and Bevel Polish	Visual Inspection	100%	Certification
Scratches and Point Defects	Visual Inspection	100%	Hand sketch or microscope image including scratch/pit dimensions together with Certification
Registration Mark Location/Orientation	Visual Inspection	100%	Certification
Registration Mark Dimensions	Visual Inspection	100%	Certification
Identification Location	Visual Inspection	100%	Certification
Identification Serial Number	Visual Inspection	100%	Certification
Surface Figure	Interferometry	100%	Surface Map
Surface Errors – Low Spatial Frequency	Interferometry	100%	Surface Map
Surface Errors – High Spatial Frequency	High Resolution Surface Map	100%	Surface maps for 3 central locations. Numerical values included with Certification

Data: For the purpose of all data collection the Registration mark shall be at the top center of the optic.

Format: All Data shall be delivered according to Table 1. In addition to the hard copy the Surface Data shall be delivered in electronic form in ASCII, OPD or .DAT format. Include a data description: aperture size, pixel size, height units. Phase difference data shall be in units of nanometers.