



SUBSTRATE, ALIGO MODE CLEANER FLAT MIRROR

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Rodica Martin, Dave Reitze	David Tanner	04-01-08		-01-	
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Applicable Documents

- D070091-A-D ALIGO Input Mode Cleaner Flat Mirror Substrate
- D070083-A-D ALIGO Input Mode Cleaner Flat Mirror Blank
- E070071-A-D Mirror Blank Material, ALIGO Input Mode Cleaner Flat Mirror (IMCF)

Requirements

Physical Configuration

Fabricate from D070091-A-D, ALIGO Input Mode Flat Cleaner Mirror Substrate

Arrow indicates Surface 1, the highly reflective surface.

Serial Number

The Serial number shall be of the format:

IMCF-YY-Z Where

YY is incremental for each optic starting at 01.

Z is the current revision letter of this specification.

Registration Marks

Registration marks and Serial Numbers shall be etched, ground or sandblasted as specified in D070091-A-D. The arrow orientation used on the Blank will be preserved if possible or changes reported in detail. Reference D070083-A-D ALIGO Input Mode Cleaner Flat Mirror Blank and E070071-A-D Mirror Blank Material, ALIGO Input Mode Cleaner Flat Mirror (IMCF).

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.

**SUBSTRATE, ALIGO MODE CLEANER FLAT MIRROR****Wedge angle**

Specified according to drawing D070091-A-D, ALIGO Input Mode Cleaner Flat Mirror Substrate

Scratches and Point Defects**Scratches and Sleeks, Surface 1**

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

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

The total area of scratches outside the central 40 mm diameter shall not exceed 25×10^3 square micrometers.

Point Defects, Surface 1

There shall be no point defects of radius > 2 micrometers within the central 40 mm diameter. 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 mm^2 . Point defects of radius less than 2 micrometers are disregarded outside the central 40 mm diameter.

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

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

Scratches, Surface 2

The total area of scratches within the central 110 mm diameter shall be as small as possible (not exceed 10×10^3 square micrometers, width times length).

The total area of scratches outside the central 110 mm diameter shall not exceed 25×10^3 square micrometers.

Point Defects, Surface 2

There shall be no more than 25 point defects of radius > 2 micrometers within the central 110 mm diameter.

There shall be no more than 90 point defects of radius > 2 micrometers on the entire surface.

Point defects of radius greater than 25 micrometers are treated like scratches for the purpose of this specification. 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 fiberoptic 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 All specified quantities refer to the physical surface of the optics.

Surface 1: Flat, measured over the central 80 mm diameter

Radius of curvature: > 80 kilometers

Astigmatism: < 10 nanometers (surface peak to valley)

Surface 2: Flat, measured over the central 140 mm diameter

Radius of curvature: > 80 kilometers

Astigmatism: < 32 nanometers (surface peak to valley)

Surface Errors

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

The following root mean square (σ_{rms}) standard deviation values are calculated from the phase maps which are to be provided with each optics. σ_{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 140 mm diameter aperture:

RMS deviation from flatness < 1/200 wave

Microroughness, Surface 2:

$\sigma_{\text{rms}} < 0.2$ nanometers

Measured at the following locations:

1. Three positions equally spaced along the circumference of a centered 56 mm diameter circle.
2. Four positions equally spaced along the circumference of a centered 83 mm diameter circle.
3. Three positions equally spaced along the circumference of a centered 110 mm diameter circle.

**SUBSTRATE, ALIGO MODE CLEANER FLAT MIRROR****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 (in-house or by subcontract)	100%	<u>Surface 1</u> : Surface maps for 3 central locations. <u>Surface 2</u> : Surface maps for four positions equally spaced along the circumference of a centered 83 mm diameter circle, and aligned with the lines and the arrow on the barrel within 10 deg. 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.