Substrate, Input Test Mass, 40M RSE Experiment

AUTHOR:	CHECKED:	DATE	APPROVALS		
			DCN NO.	REV	DATE
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Applicable Documents

LIGO-D010104-A-D	Substrate, Input Test Mass, 40M RSE Experiment
LIGO-E000408-A-D	Mirror Blank Material, Input Test Mass, 40M
LIGO-D000266-A-D	Input Test Mass Blank, 40M

Requirements

Physical Configuration

According to
LIGO-D010104 Substrate, Input Test Mass, 40M RSE Experiment

Fabricate from
LIGO-E000408 Mirror Blank Material, Input Test Mass, 40M

Part and Serial Number

The Serial number shall be per D010104 and of the format:

ITM YY Where

YY is incremental for each optic starting at 01

Registration Mark

Registration mark shall be etched, ground or sandblasted coincident with the registration mark drawn on the Blank within 5 mm. The arrow orientation used on the Blank will be preserved if possible or changes reported in detail. Reference LIGO-D000266, Input Test Mass Blank.

Side and Bevel Polish

All sides and Bevels shall be polished from a five micrometer grit finish. These surfaces shall appear transparent with no gray, scuffs or scratches visible to the naked eye when viewed in normal room light against a black background.

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Scratches and Point defects

There shall be no scratches, sleeks or point defects within the central 10 mm
The total area of scratches, sleeks and point defects within the central 30 mm diameter shall not exceed 500 square micrometers (width times length.)
The total area of scratches outside the central 30 mm diameter shall not exceed 5,000 square micrometers.

Minimum Point Defect
Point defects which have a maximum dimension of 5 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 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 that are detected will be measured using a calibrated eyepiece.
2. Further inspection will 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.

Surface Figure, measured over the central 30 mm diameter

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

Surface 1: Nominally flat.
Radius of curvature > ±5625 meters
Astigmatism: < 20 nanometers (surface peak to valley)

Surface 2: Nominally flat.
Radius of curvature > ±5625 meters
Astigmatism < 20 nanometers (surface peak to valley)

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Surface Errors, Surface 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. 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.

Low Spatial Frequency Band < 32 cm^{-1}: The surface is measured using a commercial phase measurement interferometer and calibrated reference flat. With piston, tip, tilt, power (best fit spherical surface) and astigmatism removed over the central 30 mm diameter aperture:
σ_{rms} <2 nanometers

High Spatial Frequency Band: Micro-roughness is measured with a commercial microscopic interferometer or surface profiler.
σ_{rms} < 0.1 nanometers

Measured at the following locations:
1. The center of the mirror substrate.
2. Four positions equally spaced along the circumference of a centered, 30 mm diameter circle.

Table 1 Certification Data Requirements

Specification	Test Method	Frequency of Inspection	Data Delivered
Physical Dimensions	Visual Inspection	100%	Certification
Side and Bevel Polish	Visual Inspection	100%	Certification
Scratches and Point defects	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%	Certification

Orientation: For the purpose of full surface phase maps the substrate shall be oriented such that the point of minimum thickness shall be 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 either ASCII or Vision.OPD format.