LASER INTERFEROMETER GRAVITATIONAL WAVE OBSERVATORY

SPECIFICATION

E070334	-A-	D
Drawing No	Rev.	Group

Mexican Hat Pathfinder Polish - Flat

AUTHOR:	CHECKED:	DATE	APPROVALS		
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Requirements

All 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.

Fabricate from

50.8mm diam. x 30mm thick cylindrical fused silica blank
To be supplied by QED

Bevel

3mm at 45º

Serial Number

Serial Number “MHF X” shall be written in indelible ink on the barrel of the optic, where X is a sequential number starting with 1.

Registration Marks

A registration arrow shall be drawn in indelible ink on the barrel of the optic, pointing toward Surface 1. This mark is used to reference the top orientation of the delivered data, and to provide a clocking reference for measurement comparison.

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

The total area of scratches and sleeks within the central 12 mm diameter shall not exceed 2X 10^3 square micrometers (width times length.)

The total area of scratches and sleeks outside the central 12 mm diameter shall not exceed 50 X 10^3 square micrometers (width times length.)

Scratches and Sleeks, Surface 2

The total area of scratches and sleeks within the central 12 mm diameter shall not exceed 24 X 10^3 square micrometers (width times length.)

Point Defects, Surface 1

There shall be no more than 5 point defects of radius greater than 2 μm within the central 12 mm diameter.

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There shall be no more than 50 point defects of radius greater than 2 µm on the entire surface. Average density of defects less than 2 µm radius must be less than or equal to 1 per $4mm^2$

Point Defects, Surface 2

There shall be no more than 10 point defects of radius > 2 µm within the central 12 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 fibre 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 field microscope with a similar sampling frequency as described in section 2.

Optical Surface Figure, measured over the central 26 mm diameter

Surface 1: Flat mexican hat profile as provided in attached data file (FlatMirrorXYZ.dat) and shown in attached plot. The profile data provided extends to over 50mm diameter: the initial 26mm are critical, outside of this region may be attempted at the manufacturer's discretion.

Data file (FlatMirrorXYZ.dat): Data is given in three columns x,y,z where z is the height of the profile. Dimensions are in m. The file header gives number of points and pixel size. Data points are in the centre of grid squares. NB This data can be provided in any format at any resolution desired.

Surface 2: Nominally flat.

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 desired phase map shall be subtracted from the data. Known bad pixels may be excluded from this calculation.

Surface 1, Frequency Band: < 1 mm^{-1}
Measured over the central 26 mm diameter aperture: σ_{rms} < 2.1 nanometers
Measured over the central 12 mm diameter aperture: σ_{rms} < 0.7 nanometers

Surface 2 - Frequency Band: < 1 mm^{-1}
Measured over the central 26 mm diameter aperture: σ_{rms} < 4 nanometers
Measured over the central 12 mm diameter aperture: σ_{rms} < 2 nanometers

Error, High Spatial Frequency: 1– 750 mm^{-1}

Surface 1 HSF error $\sigma_{rms} \leq$ 0.16 nanometers measured at the following location:

1. Within 2mm of the center of the surface.

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Surface 2 HSF error $\sigma_{rms} \leq 1$ nanometer measured at the following location:

1. Within 2mm of the center of the surface.

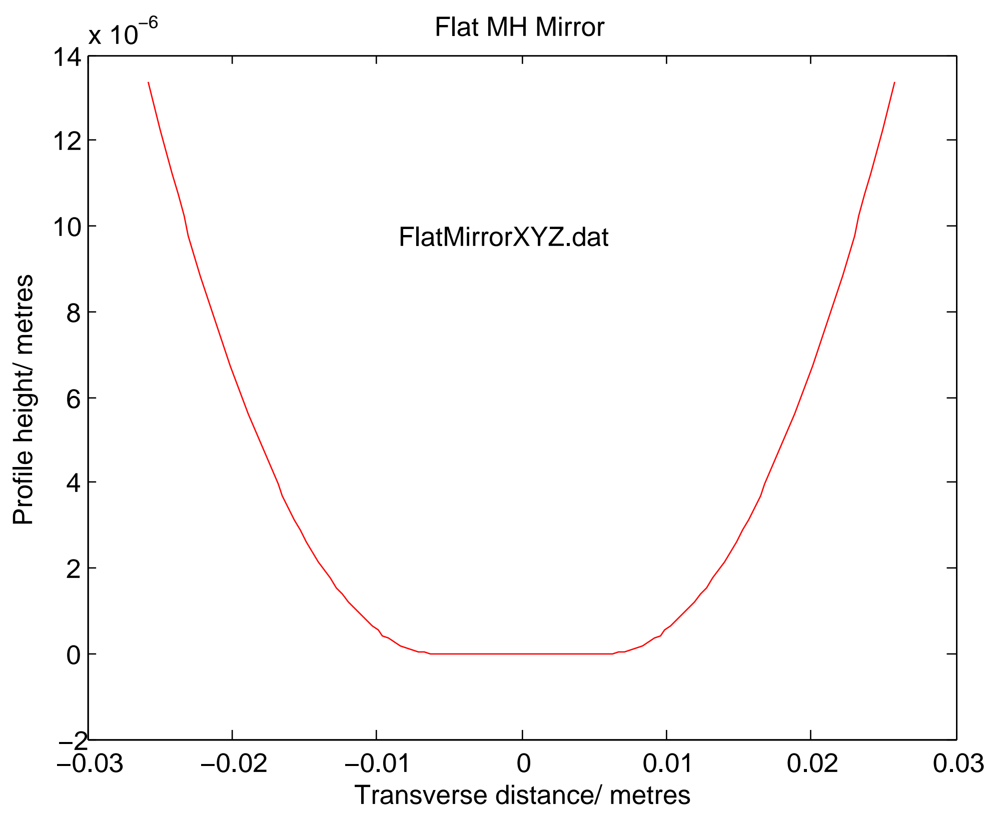
Inspection

Table 1: Inspections

Specification	Test Method	Data Delivered
Scratches and Point defects	Visual Inspection	Dark Field Microscope, visual inspection, hand sketch or camera image including scratch/pit dimensions
Figure	Interferometry	Surface phase maps
Errors - Low Spatial Frequency	Interferometry	Surface phase maps with specified figure subtracted
Errors - High Spatial Frequency	Interferometry	Surface phase map with specified figure subtracted. Numerical values included with certification

Orientation: For the purpose of full surface phase maps the substrate shall be oriented such that the registration mark 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.


Flat MH Mirror
x 10^−6
14
12
10
8
6
4
2
0
−2
FlatMirrorXYZ.dat
Profile height/ metres
−0.03
−0.02
−0.01
0
0.01
0.02
0.03
Transverse distance/ metres