



## Mode-Cleaner Optics: Mariner40m Fused Silica Plano-Concave Mirror Specifications

APPROVALS	DATE	REV	DCN NO.	BY	CHECK
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CHECKED:					
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### 1 Description

Plano-concave mirrors @ 2128nm

### 2 Material

Corning HPFS 7979 OA (high purity fused silica)

- Homogeneity:  $\leq 1 \times 10^{-6}$  peak to valley at  $\lambda = 632.8$  nm, within the 85% clear aperture

### 3 Dimensions

**Diameter:** 75.0 mm  $+0.00/-0.1$  mm

**Thickness** (at edges): 25.0 mm  $\pm 0.075$  mm

**Chamfers:** minimal to prevent chipping (goal of  $< 0.25$  mm width)

### 4 Radius of Curvature (ROC):

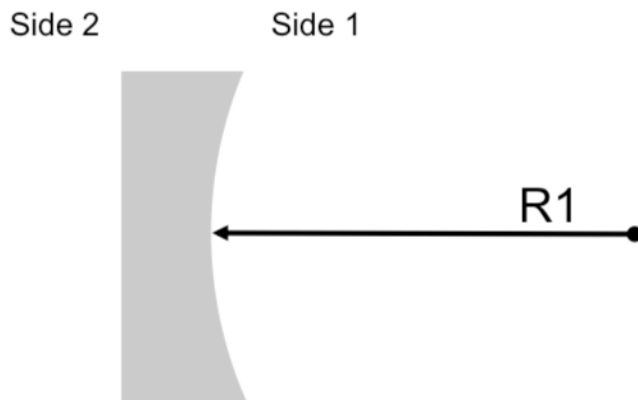


Fig1: Schematic picture of the plano-concave optics E2000544-v1-X. This picture has the only purpose of identifying the ROC of the optic and the two sides.

Side 1 Radius of Curvature values below are defined over the central 30 mm diameter of the optic.



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### 5 Surface Roughness & Quality

**Side 1: Super-polished** less than 1 Angstrom RMS over central 30 mm diameter

There shall be no scratches, streaks or point defects within the central 30 mm diameter  
20-10 scratch-dig outside central 30 mm diameter.

**Side 2: Commercial-polish**

Less than 5 Angstrom RMS over central 80% of diameter

**Edges and Bevels: Commercial-polish**

### 6 Surface Figure

**Side 1:** Over central 30 mm diameter, deviation from sphere:  $< \lambda/20$  PV at 632.8 nm

#### Surface Errors, Side 1

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

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

**Low Spatial Frequency Band:  $\leq 4.3 \text{ cm}^{-1}$**

With piston, tip, tilt, power (best fit spherical surface) and astigmatism removed over the central 30 mm diameter aperture:

$\sigma_{\text{rms}} < 5$  nanometers

**High Spatial Frequency Band:  $4.3 - 7,500 \text{ cm}^{-1}$**

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

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Specification	Test Method	Frequency of Inspection	Data Delivered
Physical Dimensions	Visual Inspection	100%	Diameter, Thickness, Bevel dimension, Wedge angle.
Side and Bevel Polish	Visual Inspection	100%	Inspection Report included with Certification
Scratches and Point defects	Visual Inspection	100%	Hand sketch including scratch/pit dimensions
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

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.



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### 7 Coating definitions (2 in total)

All coatings should cover at least central 85% diameter.

#### IMC-IC

- Description: Input mode cleaner input coupler
- Wavelength: **2128nm**
- Angle of incidence: 45°
- Ion Beam Sputtered coating
- Requirement:
- $T = 0.2\% \pm 0.02\%$  (goal  $\pm 0.01\%$ ),
- $R = 99.8\% \pm 0.02\%$  (goal  $\pm 0.01\%$ ), @2128nm, for **s**-polarization
- Absorption < 100ppm (goal < 20ppm)

#### HR0

- Description: High reflector at 0 degrees
- Wavelength: **2128nm**
- Angle of incidence: 0-5°
- Ion Beam Sputtered coating
- Primary Requirement:
- $R > 99.99\%$  (goal  $R > 99.998\%$ ) @2128nm, for **s**-polarization
- Absorption < 100ppm (goal < 20ppm)
- Secondary Requirement:
- $T < 100\text{ppm}$  (goal  $T < 20\text{ppm}$ )

#### AR0

- Description: Anti-reflection coating for 0 degrees
- Wavelength: **2128nm**, Angle of incidence: 0°, Ion Beam Sputtered coating
- Requirement:
- $R < 0.1\%$  @2128nm, for **s**-polarization

#### AR45

- Description: Anti-reflection coating for 45 degrees
- Wavelength: **2128nm**, Angle of incidence: 45°, Ion Beam Sputtered coating
- Requirement:
- $R < 0.1\%$  @2128nm, for **s**-polarization



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### 8 Deliverables

“Nominally Flat” is defined as absolute value of ROC > 6000m

- **Name: “MC1/MC3”**

- Qty 3
- Type 2 (75mm diameter)
- Side 1: Nominally flat, IMC1 coating
- Side 2: Nominally flat, AR45 coating, 2 deg wedge
- Arrow engraved on barrel at thickest part of wedge point to Side 1

*Special note: all three units must be coated in the same coating to minimize difference between optic reflectivity.*

- **Name: “MC2”**

- Qty 2
- Type 2 (75mm diameter)
- Side 1: ROC R1 = + **17.87 m ± 0.03 m**, HR0 coating
- Side 2: Flat, AR0 coating, 2 deg wedge
- Arrow engraved on barrel at thickest part of wedge point to Side 1

- **Spectrophotometry data** for coatings (in form of CSV file of measured values, not a processed plot)

- AR0: measured reflection at or close to 0° AOI
- AR45: measured reflection at 45° AOI (both polarizations)
- HR0 coating: measured reflection and transmission at or close to 0° AOI
- HR45 coating: measured reflection and transmission at 45° AOI (both polarizations)



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### 9 Serial numbers and marks

- Each optic shall be laser engraved on the barrel of the optic for in-vacuum use — **no pencil marks shall be present**
- Each optic shall be labelled as follows:
  - “E2000544-v2-NNN SN0x HR 2128nm”
  - with ‘NNN’ the unit name letter designator given above
  - with ‘x’ starting at **1** for each type

#### 9.1 Explicit labels

- E2000544-v1-MC1/MC3 SN01 HR 2128nm
- E2000544-v1-MC1/MC3 SN02 HR 2128nm
- E2000544-v1-MC1/MC3 SN03 HR 2128nm
  
- E2000544-v1-MC2 SN01 HR 2128nm
- E2000544-v1-MC2 SN02 HR 2128nm