Polishing Specifications of the Advanced VIRGO + Power Recycling Mirror 3

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CHANGE RECORD

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Authors:	**Date**	**Signature**
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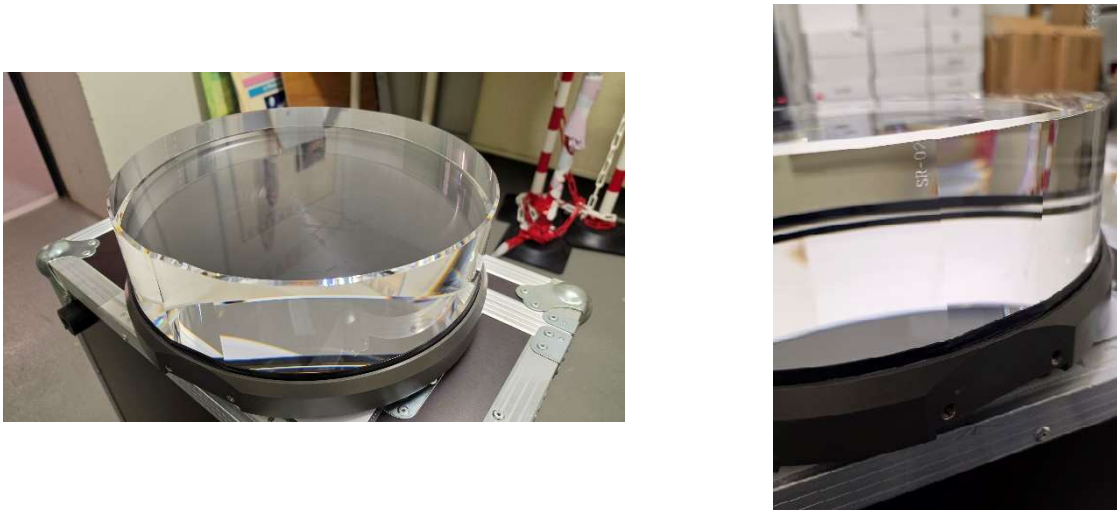
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1. Introduction

The aim of this document is to describe the polishing specifications of the Advanced VIRGO + Power Recycling Mirrors n°3 (PR3). The two blanks silica substrates are provided by LMA. They are already polished (see pictures below) with other specifications. The dimensions (diameter, thickness) of these blanks are compatible with the final PR3 dimensions asked to the polisher.
Surface 1 and 2 (Figure 1) must be repolished with the specifications described in the table page 7. The surfaces 3 and 4 (flats) and surface 6 are already polished with the good specifications. They must be protected during the new polishing phase.



Picture 1: Photos of the Advanced Virgo Power Recycling Mirror 3 as they are now before shipment

2. PR3 Technical Specifications

Physical Dimensions
The technical drawing of the PR3 can be seen on Figure 1

Serial Number, Surface 1
Serial number of the PR are already etched as indicated on Figure 1. The PR substrates are serialized: PR - 01 and PR – 02.
An arrow etched on the side (see Figure 1) of the PR indicates the Surface 1 (concave).

Chamfers, Side
All the PR substrates must have a polished chamfer on Surface 1 and Surface 2: width 2 mm +/- 0.5 mm at 45°.
The edge of the barrel is already polished all around (Surface 5 and 6) and they must be protected during the polishing of Surface 1 and 2 to still be transparent with no apparent scratches that can be seen by eyes in a normal room light.

Lateral Flats

Two lateral flats (Surface 3 and 4) are already polished on the PR3 substrates as shown on Picture 1. They must be protected during the repolishing of Surface 1 and 2. The polisher will be responsible for any damage to these surfaces.

Flatness – Surface error, low spatial frequencies domain (< 1 mm^{-1})
The root mean square deviations are calculated from the phase maps after subtraction of the four first Zernike terms ($Z_{0,0}$, $Z_{1,1}$, $Z_{2,0}$, $Z_{2,2}$) or corresponding Seidel aberration. For Surface 1, the astigmatism amplitude must be lower than 5 nm on the 70 mm central area (amplitude of the Zernike coefficient $Z_{2,2}$).

RMS Roughness – Error, high spatial frequencies domain
The RMS roughness must be measured in the central part (inside 5 mm circle), on four positions equally spaced along the circumference of a 50 mm diameter circle.

Packaging
The blank substrates will be shipped by LMA to the polisher. Each part will be packaged in special protective box (special “plastic” caps) that guarantee the substrate integrity during shipment. The polisher can use the same box to ship the substrates after polishing to LMA.

The PR substrates must be delivered after polishing at:

Laboratoire des Matériaux Avancés
Bâtiment VIRGO
7, Avenue Pierre de Coubertin
69622 – Villeurbanne Cedex FRANCE

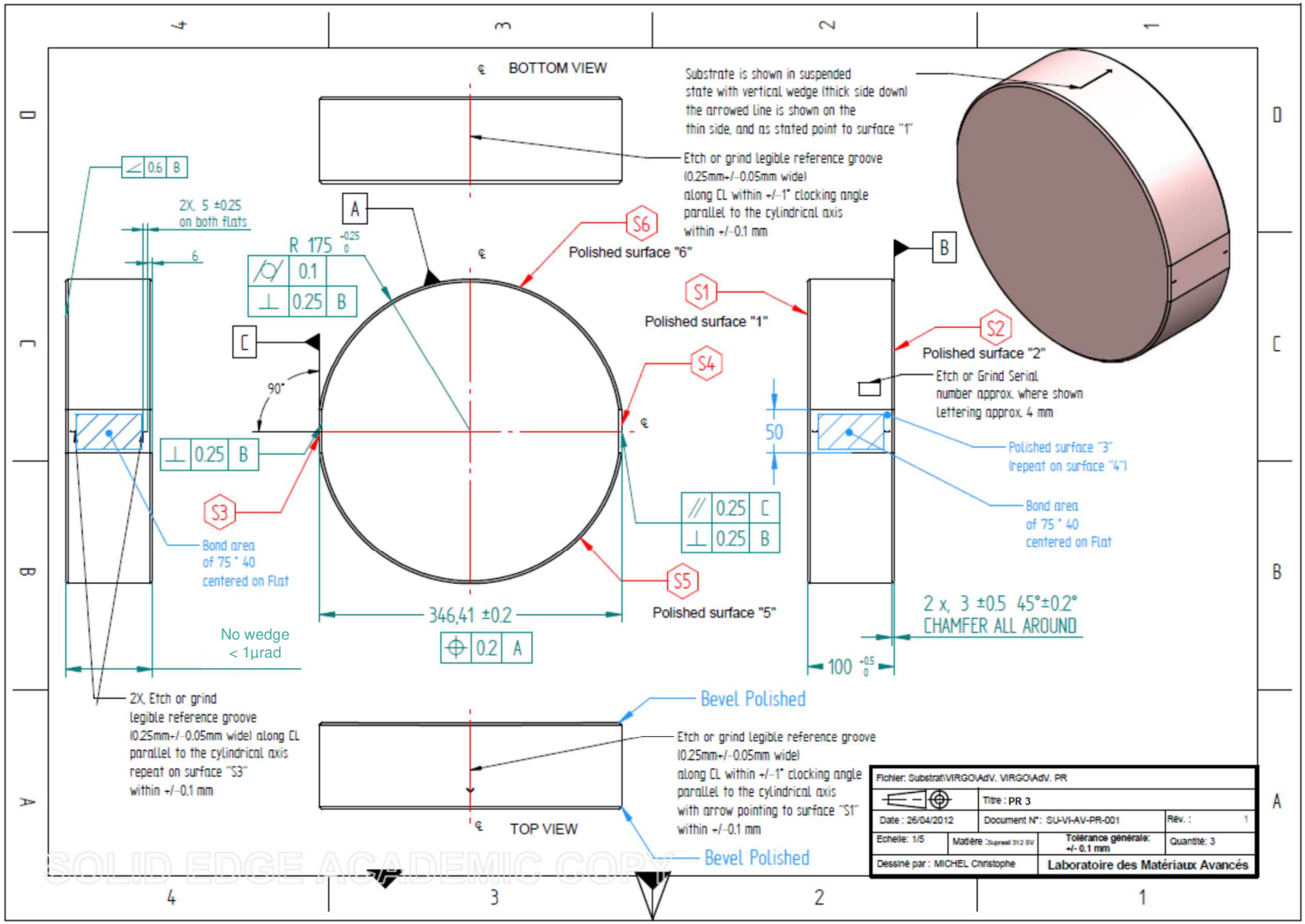


Figure 1: Drawing of the Advanced Virgo Power Recycling Mirror 3

The table below summarizes all the specifications of the PR3 substrates.

Properties		**Specifications**
Diameter (mm)		350 -0/+0.5
Thickness (mm)		100 -0.5/+0
Wedge		No wedge, < 1µrad
Chamfers		3 mm +/- 0.2 mm at 45°
Lateral Flats	Dimensions (mm)	100*50
	Roughness (nm)	< 1 nm on 75*40 mm centered on the flat
	Flatness PV (nm)	< 60 nm on 75*40 mm centered on the flat
Radius of curvature (m)	Surface 1	Spherical, **Concave**, ROC = 20 m +/- 0.2 % on ∅150 mm central area
	Surface 2	Spherical, **Convex**, ROC = 1.837 m +/- 0.2% on ∅150 mm central area
RMS Flatness (nm) Surface error , low spatial frequencies f (< 1 mm^{-1})	Surface 1	< 0.5 nm on ∅150 mm central area < 2 nm on ∅300 mm central area Astigmatism amplitude < 5 nm ($Z_{2,2}$ amplitude) ∅150 mm
	Surface 2	< 2 nm on ∅150 mm central area < 4 nm on ∅300 mm central area
RMS Roughness (nm) high spatial frequencies	Surface 1	< 0.1 nm on ∅150 mm central area
	Surface 2	< 0.1 nm on ∅150 mm central area
Surface defects (point defects scratches)	Surface 1	Defects ∅< 5µm : density < 5/4 mm^2 in ∅150 mm Defects ∅∈ [5µm, 50µm] : <50 in ∅150 mm Defects ∅∈ [5µm, 50µm] : <200 in ∅300 mm Defects ∅> 50µm : total area < 500.10^3 μm^2 in ∅150 mm
	Surface 2	Defects ∅∈ [5µm, 50µm] : <300 in ∅150 mm Defects ∅> 50µm : total area < $500x10^3$ μm^2 in ∅150 mm

3. Technical data to be produced by the manufacturer at the substrate delivery

For each Advanced Virgo PR3 substrate, a complete documentation must be provided. This documentation must include the measurement for each surfaces described below in the Measurement Matrix (Table 1).

Requirements	**Method**	**Data Delivered**
Physical Dimensions	Measurement	Diameter Thickness
Scratches, Point defects	Visual Inspection	Inspection Report with a digital image or hand sketch including scratch/Points dimensions
ROC	Interferometric Measurement	Surface phase map
RMS flatness, surface error	Interferometric Measurement	Surface phase maps
RMS roughness	Interferometric Measurement	Surface maps for 3 central locations. Numerical values included with certification

Table 1 : Measurement Matrix

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 format or ZYGO interferometer data format (.DAT).