THE UNIVERSITY OF ARIZONA®

# Procurement and Contracting Services

# ADDENDUM # 1

## Request for Bid
## For
## ARGOS Large Aspheric Mirror

Please mark all proposal submission envelopes with the following information:

## RFB # S111001.01

**The attention of Bidders submitting proposals for the subject Contract is called to the following Addendum. The revisions set forth herein, whether of omission, addition or substitution, are to be included in and form a part of the Proposal submitted.**

Q1. Concerning the polishing accuracy of the 2 surfaces : do you confirm that the aspherical surface needs to be polished with a better quality (i.e. L/10 PTV is specified) than the flat surface (i.e. L/5 PTV is specified) ?.Generally, it is the reverse situation for such kind of lens just because the spherical surface is for sure more difficult to polish and test than the flat one

**A1. The wavefront tolerances for Surface 1 and 2 were reversed. This has been corrected on both the drawing Rev D. and the Specification sheet dated October 16, 2009 (attached).**

Surface 1, the convex aspheric surface, should have < λ/5 PTV surface error over 98% of the clear aperture (392 mm) and < λ/20 RMS surface error over 100% of the clear aperture (400 mm) at λ = 632.8 nm. Surface 2, the plano surface, should have < λ/10 PTV surface error over 98% of the clear aperture (392 mm) and < λ/40 RMS surface error over 100% of the clear aperture (400 mm) at λ = 632.8 nm.

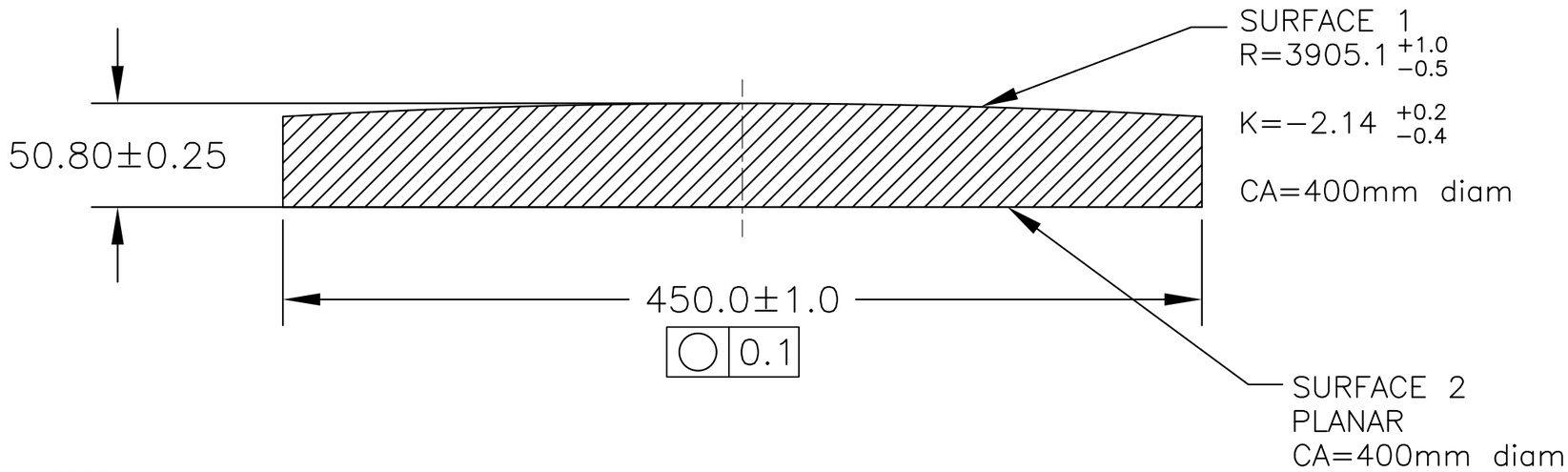
**Email statement:**

*********ATTENTION ADDENDUM NOTICE***************

Attached please find Addendum 1 to RFB S111001

This addendum will be posted online at:
http://pacs.web.arizona.edu/purch/vendor/vendorrfp.htm

| REVISIONS | | | | |
|---|---|---|---|---|
| LTR | DESCRIPTION | DATE | REVISED BY | APPROVED |
| A | INITIAL RELEASE | 04/04/09 | J. VALENZUELA | |
| B | REVISED SPECIFICATIONS | 08/31/09 | O. DURNEY | |
| C | REVISED SCRATCH–DIG SPECIFICATIONS | 09/29/09 | O. DURNEY | V. GASHO |
| D | CORRECTED FLATNESS SPECIFICATIONS | 10/16/09 | O. DURNEY | |




SPECIFICATIONS:

1) ALL DIMENSIONS IN MILLIMETERS
2) BEVEL ALL EDGES 45° TO 1.5mm RADIALLY (2.1mm FACEWIDTH)
3) OPTICAL AXIS OF ASPHERE MUST BE CONCENTRIC WITH MECHANICAL AXIS TO WITHIN 0.25mm
4) WEDGE OVER 450mm MUST BE WITHIN 0.01°
5) ASPHERIC SURFACE 1 FLATNESS 1/5TH WAVE PTV AND 1/20TH WAVE RMS AT 632.8nm OVER 400mm CLEAR APERTURE
6) ASPHERIC SURFACE 1 ROUGHNESS <15 ANGSTROMS RMS (FINALIZE POLISHING WITH PITCH AND ROUGE)
7) PLANAR SURFACE 2 FLATNESS 1/10TH WAVE PTV AND 1/40TH WAVE RMS AT 632.8nm OVER 400mm CLEAR APERTURE
8) PLANAR SURFACE 2 ROUGHNESS <15 ANGSTROMS RMS (FINALIZE POLISHING WITH PITCH AND ROUGE)
9) INDEX UNCERTAINTY ±20ppm
10) MATERIAL IS CORNING HPFS STANDARD GRADE FUSED SILICA: GRADE "A" CLASS "1"
    10a) INDEX HOMOGENEITY <1ppm
    10b) TOTAL INCLUSION CROSS SECTION <0.10mm^2/100cm^3 & MAXIMUM SIZE 0.28mm
11) SCRATCH DIG: PLANAR SURFACE 60–40, CONVEX SURFACE 60–40.
12) POLISH EDGES, BEVELS
13) COATING PERFORMANCE PLOT SUPPLIED BY VENDOR (ACTUAL AND/OR THEORETICAL)

INCHES

INTERPRET DIMENSIONS AND TOLERANCES IN ACCORDANCE WITH ASME Y14.5M–94

TOLERANCES
UNLESS OTHERWISE SPECIFIED

| LINEAR | ANGULAR |
|---|---|
| .X = ±– | ±– |
| .XX = ±– | |
| .XXX = ±– | |

DIAMETRICAL
SEE SPEC S–002

DIMENSIONS ARE IN INCHES / DIMENSIONS IN [ ] ARE METRIC

MATERIAL
CORNING HPFS
GRADE A CLASS 1

FINISH
SEE SPECS

THIS DRAWING CREATED IN:

| ACAD | MECH | IDEAS |
|---|---|---|
| [X] | [ ] | [ ] |

| NEXT ASSY | USED ON |
|---|---|
| | |
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ASSEMBLY APPLICATION

Steward Observatory, University of Arizona
933 N. Cherry Avenue, Tucson, AZ 85721 (520)621–7659

| | | |
|---|---|---|
| DESIGNED BY: J. VALENZUELA | DATE: APR 8, 2009 | CATEGORY: ARGOS LASER LAUNCH TELESCOPE |
| DRAWN BY: J. VALENZUELA | APR 8, 2009 | PROJECT: ARGOS |
| CHECKED BY: J. NOENICKX | 09/29/09 | TITLE: LLT LARGE ASPHERE LENS |
| APPROVED: V. GASHO | 09/29/09 | |
| APPROVED: | | |
| APPROVED: | | PLOT SIZE: B / SCALE: / DRAWING NUMBER: ARGOS–001 / REVISION: D |
| APPROVED: | | |

CURRENT TIME/DATE/FILE LOCATION:
DRAWING ARCHIVE LOCATION:

**Addendum #1** **October 16, 2009**

# Technical Specifications for the Advanced Rayleigh Ground layer adaptive Optics System (ARGOS) Large Aspheric Lens

The *Advanced Rayleigh Ground layer adaptive Optics System (ARGOS)* is a laser-based instrument that will mount directly on one of the wind-bracing platforms of the *Large Binocular Telescope (LBT)*. Two identical systems will be built: one for each of the 8.4m primary 'eyes'. The *ARGOS* instrument requires the procurement of two (2) large aspheric lenses.

The large aspheric lens is the final powered optic for the *Laser Launch Telescope (LLT)*. Its purpose is to focus the three (3) high-powered 532 nm laser beams to a height of 12 km into the atmosphere, thus generating bright guide stars. The telescope will use these guide stars for alignment and atmospheric wavefront correction. The lens will require tight tolerances on the surface quality, roughness, and surface wavefront error based on high laser power per unit area at the lens surfaces and optical constraints of the focused laser spot. The lens is convex-plano in shape, with a relatively small aspheric (hyperbolic) departure. The physical specifications are as follows: $R_1$ = 3905.1 mm +1.0 / -0.5, $R_2$ = Infinity; $k_1$ = -2.14 +0.2 / -0.4, $k_2$ = 0; 450 mm ± 1.0 diameter; 400 mm clear aperture; and 50.8 mm ± 0.25 center thickness.

**SCOPE OF WORK:**
Vendor will provide lens blanks. The substrate material is a Corning High Purity Fused Silica (HPFS). Given the laser power requirements, the substrate must have low index homogeneity and low bubble inclusions. Homogeneity should be less than 1 ppm, Grade A. Inclusions should be smaller than 0.10 $mm^2$ per 100 $cm^3$ and have a maximum diameter of 0.25 mm, Class 1. Vendor must provide copy of material certifications to the University prior to polishing.

Surface 1, the convex aspheric surface, should have < λ/5 PTV surface error over 98% of the clear aperture (392 mm) and < λ/20 RMS surface error over 100% of the clear aperture (400 mm) at λ = 632.8 nm. Surface 2, the plano surface, should have < λ/10 PTV surface error over 98% of the clear aperture (392 mm) and < λ/40 RMS surface error over 100% of the clear aperture (400 mm) at λ = 632.8 nm.

The surface quality should be better than 60-40 across the entire clear aperture. The micro-roughness post-polish should be less than 15 Angstroms. All edges of the lens should have a 1.5 mm bevel at 45 degrees. This corresponds to a 2.12 mm face width on the bevel. The vendor is asked to polish both bevels and the outside edge of the lens to an inspection level polish (SQ of 80-50 with roughness of < 50 nm).

The vendor shall provide an anti-reflection coating on both surfaces of the lenses. The coating should have a reflectance of less than 0.1% at 532 and 589 nm. A test run with a witness sample confirming the reflectance spec is required before the actual lens coating run.

The vendor shall demonstrate that the lenses meet these specifications using their test setup. They will provide 9 to 10 meters of horizontal test space for a secondary full-system test setup provided by the University of Arizona. If the lenses do not meet spec via vendor tests, they will be re-figured at no charge. The vendor shall deliver the lenses on or before TBD (*9 months*).

| | Large Aspheric Lens (LAL) |
|---|---|
| Description (qualitative) | On-axis, convex-plano, aspheric lens [surface 1 ($S_1$) is aspheric, surface 2 ($S_2$) is plano] |
| Substrate Material | Corning HPFS, Grade A, Class 1 |
| - HPFS | High Purity Fused Silica |
| - Homogeneity Grade A | ≤ 1 ppm |
| - Inclusion Class 1 | ≤ 0.10 $mm^2$/ total cross section, 0.28 mm max size |
| - Index Uncertainty | ≤ 20 ppm/K @ 532 nm |
| Diameter [mm] | 450.0 ± 1.0 |
| Clear Aperture [mm] | 400.0 (88.9%) |
| Center Thickness [mm] | 50.80 ± 0.25 |
| Radius $R_1$ [mm] | 3905.1 + 1.0 / - 0.5 |
| Radius $R_2$ [mm] | Infinity (plano) |
| Conic Constant $k_1$ | -2.14 + 0.20 / - 0.40 |
| Conic Constant $k_2$ | - |
| PTV Surface Error for $S_1$ over 98% of Clear Aperture (392 mm) @ 632.8nm | < λ/5 |
| RMS Surface Error for $S_1$ over 100% of Clear Aperture (400 mm) @ 632.8nm | < λ/20 |
| PTV Surface Error for $S_2$ over 98% of Clear Aperture (392 mm) @ 632.8nm | < λ/10 |
| RMS Surface Error for $S_2$ over 100% of Clear Aperture (400 mm) @ 632.8nm | < λ/40 |
| Wedge over full Diameter [arcsec] | < 36 (0.01°) |
| RMS Surface Micro-roughness [nm] | < 1.5 |
| Surface Quality (scratch/dig) | 60–40 |
| Total Indicated Runout (TIR) [mm] | 0.1 |
| Concentricity of optical axis to mechanical axis [mm] | < 0.25 |
| Bevel | 1.5 mm x 45°, (2.12mm face width), polish (SQ of 80-50, roughness of < 50 nm) |
| Edge Surface | polish (SQ of 80-50, roughness of < 50 nm) |
| Anti-reflection coating @ 532 & 589 nm | < 0.1% |
| | |
| Delivery Date [9 months ARO] | *August 2010* |
| | |

**Table 1**: Lens Specification Summary