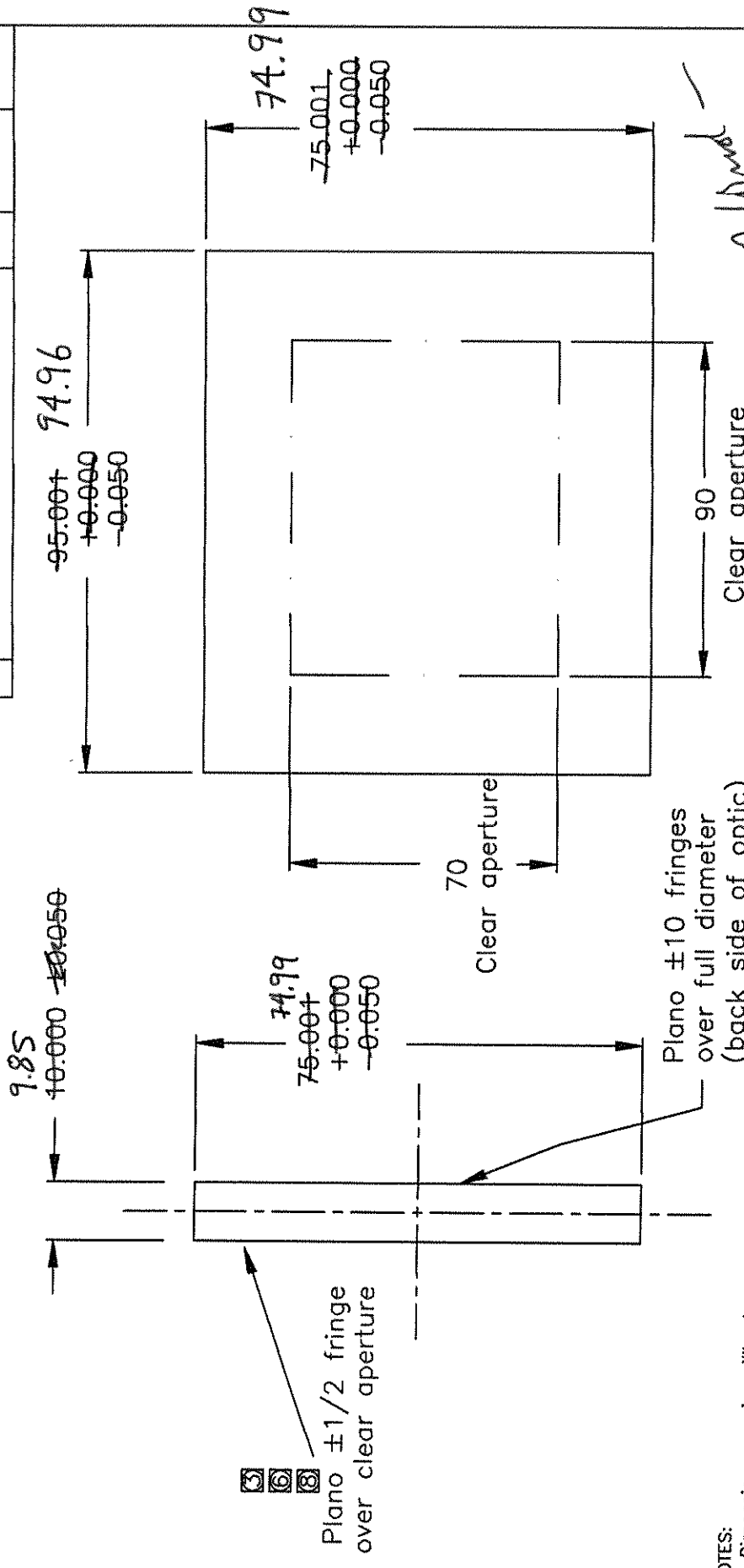


| REVISIONS | | |
|-----------|----------------------|-------------------|
| LTR | DESCRIPTION | DATE |
| B | Decreased dimensions | 6/19/99 R. Sarlot |



- NOTES:
- 1) Dimensions are in millimeters
 - 2) Polished to full diameter
 - 3) Optical Surface: < 16.65um rms figure < 10A rms micro roughness/finish
 - 4) Wedge < (11R-50um)
 - 5) Clear aperture - 70mm diameter x 90mm diameter
 - 6) ~~Pure gold coating for 1-5um high reflectivity~~ ^{234nm}
 - 7) Bevel all edges with 0.5mm face width max by 45 degrees
 - 8) Scratch and dig spec: 60/40 per mil-0-13830A
 - 9) All surface dimensions are at standard temperature and pressure
 - 10) Request inspection report based on final data

CONTACT: ROLAND SARLOT 520-626-7252
 Steward Observatory, University of Arizona
 933 N. Cherry Avenue, Tucson, AZ 85721 (520)621-7859

| | | |
|--|-----------------------------|--|
| DESIGNED BY: R. SARLOT | DATE: 05/08/98 | PROJECT: ARIES |
| DRAWN BY: R. SARLOT | CHECKED BY: Don McCarthy | TITLE: Fold Flat after Slit Plane Rectangular Mirror |
| APPROVED: | APPROVED: | PLAT SIZE SCALE: A None |
| APPROVED: | APPROVED: | DRAWING NUMBER: 10448 |
| JOB NO.: | ACTIVITY CODE: | REVISION: B |
| CURRENT TIME/DATE/FILE LOCATION: E:\jmsarlot\ARIES\1071_08/23/98 11:18 | | |
| FILE ARCHIVE LOCATION: | | |

Inspection Report

Part Number:

10442

Part Name:

Off Axis Parabola Collimating Mirror

Date:

10-Jan-01

| Parameter | Specification: | Measured Value | Method of measurement: |
|--------------------------------------|--|----------------------------------|--|
| Diameter | 160.002 +0/-0.05mm | 159.83 +/- 0.03 mm | Vernier Caliper |
| Radius | 1500.02 +/- 5.000mm | 1495.5 +/- 0.4 mm | Ronchi grating at Center of curvature measured with steel tape. |
| Conic | -1.000 +/- 0.020 | -1 | Optical test setup - autocollimation with flat. |
| Center Thickness | 25.400 +/- 0.050mm | 26.44 +/- 0.01 | Caliper |
| Wedge | <0.0036° (10μ tir) | See Perpendicularity | Autocollimation with theodolite for optical testing before cutting. Remaining coma from interferometry included. |
| Clear Aperture | 140 mm min | 140 mm min | Defined as mask for optical testing. |
| Surface Roughness | 10Å rms | Consistent with pitch polishing. | Not measured |
| Scratch & Dig | 60-40 per Mil-O-13830 | No visible scratches | Visual Inspection. No standard available. |
| Off Axis dimension: | 75.186 +/- 1.00 | 75.2 +/- 0.5 | Based on cutting procedure. See processing plan. |
| Alignment marks: | Optical & Mechanical Center | As required | Based on cutting procedure. See processing plan. |
| Figure: | <35.2 nm rms | 34 nm rms | Autocollimation test after cutting. Durango software. <i>rework as dig</i> |
| Rear Surface Figure | Plano +/- 10 fringes | >10 fringes | Measured with testplate before cutting |
| Rear surface Perpendicularity | Per Wedge Spec <i>10μm</i> <i>12.9 arc sec</i> | 28.3 +/- 13.4sec | Autocollimation with theodolite for optical testing before cutting. Remaining coma from interferometry included. |

Comments on inspection data for ARIES parabola (Dwg 10442):

Diameter:

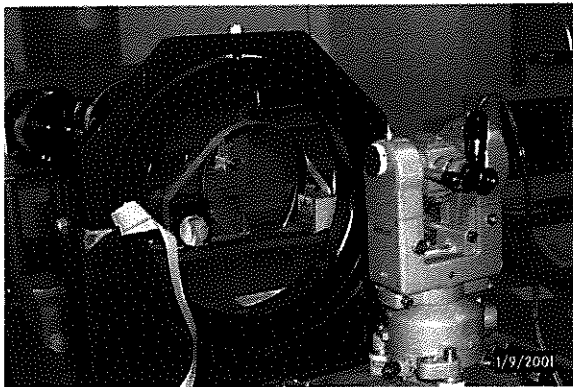
The out of specification condition may be attributed to machine wear (I think). I used the Bridgeport mill in the Room 113 and mounted a dial indicator to the horizontal ways in order to monitor the "precise" movement. I was taking light cuts as I approached the final diameter and stopping to measure the diameter with an electronic caliper. Just prior to the last cut I made, I measured the diameter at 0.001" over the upper limit of the tolerance. I bumped the position in by 0.0005 inches based on the dial indicator and made the final cut. When I measured the diameter I learned that the diameter had been reduced by almost 3 times the amount I should have been.

Center thickness:

I have no explanation for this. In checking through the optician's notes, after generating the center thickness was recorded as 1.040 inches. This means that at the center of the off axis part, the thickness was 28.3 mm. I think the optician mis-interpreted the drawing.

Wedge and Rear surface perpendicularity:

The parts were made with the flat reference surface finished first. (A copy of the process plan is attached). Throughout the remainder of processing, the wedge was minimized to the accuracy possible with our machinery. In order to verify the axis perpendicularity, I used a theodolite to make the rear surface of the parabola parallel with the flat used to autocollimate.



from the setup.

This photo shows the theodolite behind the parabola for testing after it was cut from the parent.

The data used to calculate the perpendicularity was taken while the parabola was still full size. I aligned the theodolite to the flat and then slipped in the parent parabola and aligned it to the theodolite. Then I positioned the interferometer to capture the return image



The reticle lines of the theodolite are spaced 10 seconds apart so splitting them with the return image allows me to get things aligned to about 5 seconds, maybe better. The specification works out to about 13 seconds.

This photo shows the autocollimating flat and interferometer. Since the axis of the parabola is actually on the part, a portion of the parabola is not sampled in this test.

After collecting the phase data, I note the value of the sine & cosine terms for Zernike coma. RSS'ing them together gives me the resulting coma magnitude. Buddy Martin calculated for me the corresponding amount of coma expected for a given tilt in the autocollimation test, corresponding to a perpendicularity error with the rear surface. It turns out that for each second of tilt, we get 1.3 nm rms of coma.

I made several measurements of the surface each time aligning the part to the theodolite. From the Zernike coefficients, I calculated the value in the inspection report. I am surprised it is out of spec given the care we took in fabrication. I realize now that part of the error comes from tilting the transmission sphere of the interferometer to manipulate the fringes in the test. Furthermore, the off axis location of the segment is rather loose so some of the error apparently in axis tilt might be compensated by decentering within the allowable tolerance. I simply didn't have the motion control available to me to precisely position the mirror for testing. It may turn out the mirror could be manipulated to meet the tilt specification.

Alignment marks:

The method used to mark and cut the off axis segment is given in the process plan. The parent parabola is edged and de-wedged early in the process so the OD acts as the centration reference. By locating a mark at the mechanical center and laying out the segment relative to that, the off axis distance may be held to about 0.01". Then the rough cut part is placed on a rotary table and aligned to a mark at the center of the segment and then edged circular

As can be seen in the photos in this report, the cut segment was tested in autocollimation. Again, I used the theodolite to align the flat and rear surface of the parabola parallel to about 5 seconds. Then, the interferometer is moved until the return image coincides with the source and fringes are produced. Now, in an off axis segment, coma appears like astigmatism. So the Zernike coefficients for astigmatism should give some indication of the axis tilt and part decenter. We haven't yet completed this analysis.

Remove

TI

Power

Asstg

Comp Spn

Sym

Asym

Flat

Invert

March

Flt

3D

Map

OPD Map [1:1]

OPD

Phase

Flt

Map

Shift

Intensity

Slope

Frame

Comp A

Comp B

Comp C

Comp D

Comp E

Comp F

Comp G

Comp H

Comp I

Comp J

Comp K

Comp L

Comp M

Comp N

Comp O

Comp P

Comp Q

Comp R

Comp S

Comp T

Comp U

Comp V

Comp W

Comp X

PV 231.5 nm RMS 34.26 nm

3D View of OPD Map

OPD Map [1:1]

| Coef# | Approximation |
|---------------------------------------|---|
| <input type="checkbox"/> 1 | -225.6941 1 |
| <input checked="" type="checkbox"/> 2 | 53.9294 R cos(A) |
| <input checked="" type="checkbox"/> 3 | 119.7136 R sin(A) |
| <input checked="" type="checkbox"/> 4 | 70.8559 R ² cos(2A) |
| <input checked="" type="checkbox"/> 5 | -5.4636 2R ² - 1 |
| <input checked="" type="checkbox"/> 6 | -41.4602 R ² sin(2A) |
| <input checked="" type="checkbox"/> 7 | -21.6939 R ³ cos(3A) |
| <input type="checkbox"/> 8 | -13.2352 (3R ³ - 2 R) cos(A) |

Notes

Date/Time: Tue Jan 05 2001 14:04:37

ADD SAI: 536-973076077

Job: ARIES

Title: Parabola

Part No.: 10442

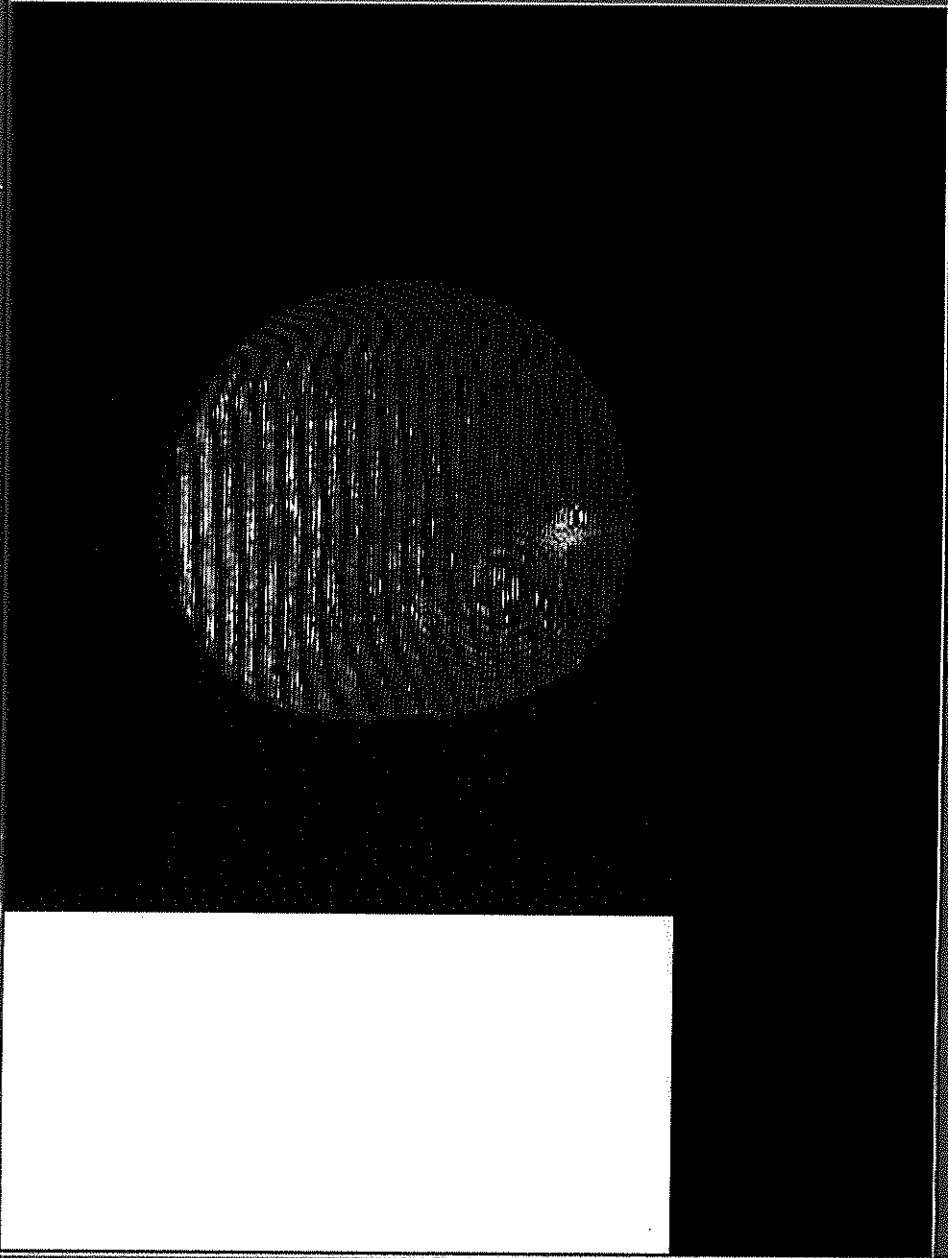
Serial No.: 1

Surface:

Operator:

Instrument:

Notes: After cutting and etching. Autocollimation with 10" flat. Axis is at left. Interferometer hot spot masked out. Average of 10.

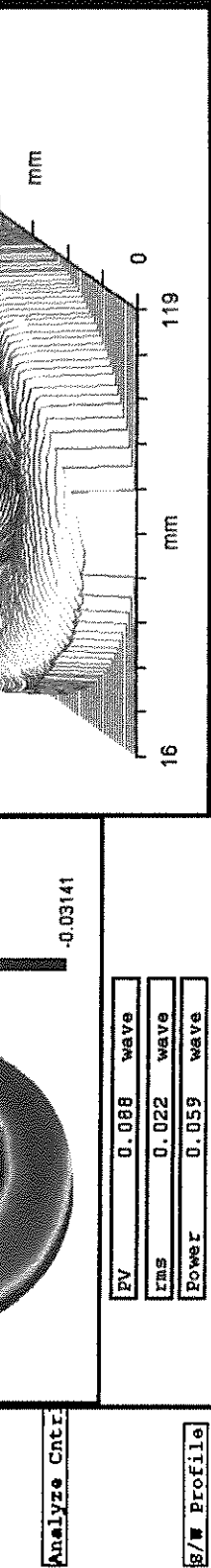


MEASURE Analyze Mask Data Save Data Load Data Calibrate Reset

Analyze Contr

Remove: EBF TLF Trimmed: 2

Aperture OD (%): Aperture ID (%): Filter: Off



Removed: EBF TLF Trimmed: 2

Aperture OD (%): Aperture ID (%): Filter: Off

Measurement Controls

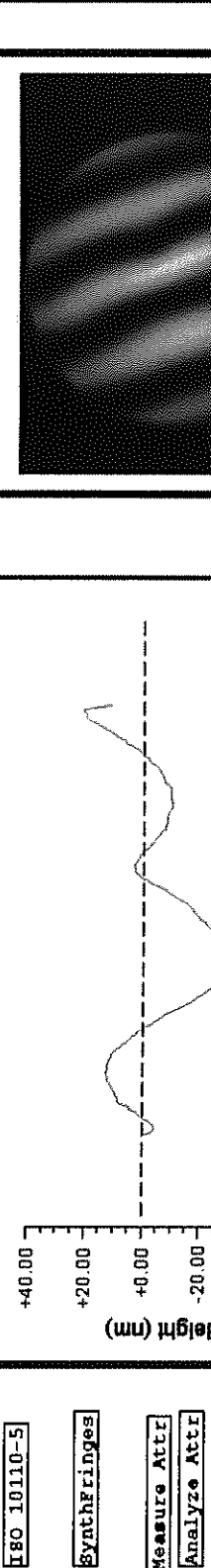
Comment: U of A Fused Silica Rotating Mirror Plano

Drawing Number: 10489 Phase Res: High

Purchase Order Number: P620886 ACC: On

Instrument: Mark GPI Id 0 SN 4624 88 0 Phase Avgs: 0

Data Sign: Normal Intens Avgs: 0



Z490 Intensity Map

Remove: EBF TLF Trimmed: 2

Aperture OD (%): Aperture ID (%): Filter: Off

Measurement Controls

Comment: U of A Fused Silica Rotating Mirror Plano

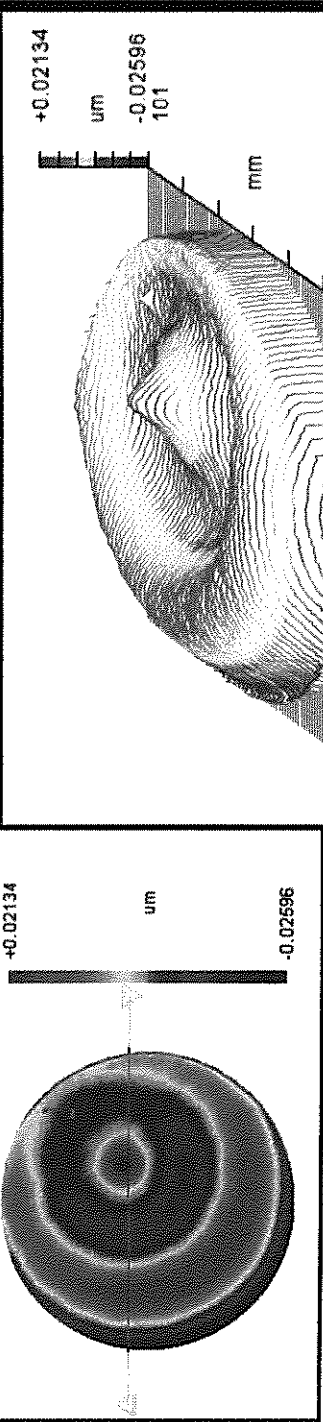
Drawing Number: 10489 Phase Res: High

Purchase Order Number: P620886 ACC: On

Instrument: Mark GPI Id 0 SN 4624 88 0 Phase Avgs: 0

Data Sign: Normal Intens Avgs: 0

Z490 Intensity Map



PV 0.075 wave
 RMS 0.014 wave
 Power 0.059 wave

- MEASURE
- Analyze
- Mask Data
- Save Data
- Load Data
- Calibrate
- Reset

Analyze Cntr.

S/W Profile

Slope Mag
 Slope X
 Slope Y

PBF
 MTF
 MTF Profile
 Zernikes

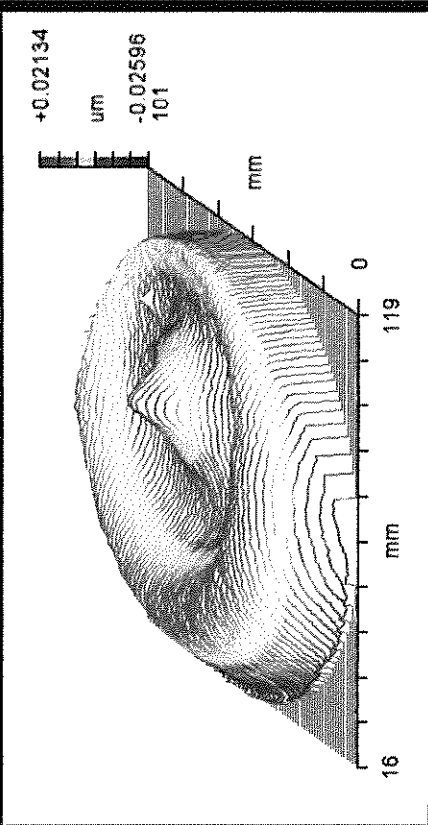
ISO 10110-5

Synthesinges

Measure Attr
 Analyze Attr

Process
 Report

Units
 Video Monitor

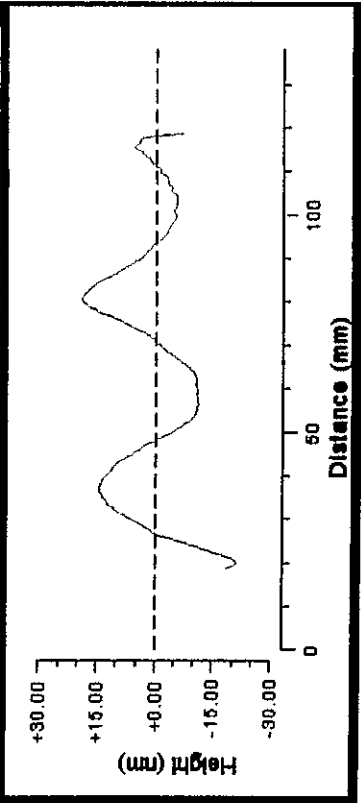


Removed: PST TLT PWR
 Aperture OD (%):
 Aperture ID (%):
 Trimmed: 2
 Filter: Off

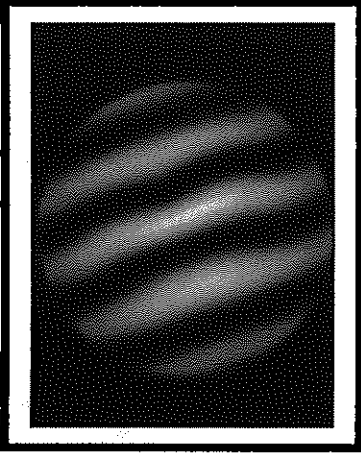
Measurement Controls

Comment: U of A Fused Silica Rotating Mirror Plano
 Drawing Number: 10489
 Purchase Order Number: P620086
 Instrument: Mark GPI Id 0 SN 4624 SB 0
 Data Sign: Normal
 Phase Res: High
 AGC: On
 Phase Avgs: 0
 Intens Avgs: 0

Surface/Wavefront Profile



Intensity Map



rotating MIRROR

| | | | | INSPECTION DATA | | |
|-----------------------------|---------------------------------------|--------------------------|-------------------------|------------------------------|-------------------------|---------------------|
| Customer PO# <i>P252602</i> | | | | WO# <i>1300-03</i> | PN <i>4508</i> | Date |
| Full Quantity <i>1</i> | | Quantity Tested <i>1</i> | | Material <i>Fused Silica</i> | <i>10448B</i> | Lot # <i>1</i> |
| Parameter | | Specifications | | Parameter | | Specifications |
| N | | NOM | TOL | N | NOM | TOL |
| 1 | Diameter of Length | <i>95.001</i> | <i>+1.000 -.050</i> | 11 | Irreg. S1, Fr. or Wv. | <i>16.65 nm rms</i> |
| 2 | Width | <i>75.001</i> | <i>+1.000 -.050</i> | 12 | Surface Quality / SD S1 | <i>60/40</i> |
| 3 | Clear Aperture 1, mm | <i>90 x 70</i> | | 13 | Radius S2, mm | <i>∞</i> |
| 4 | Clear Aperture 2, mm | <i>90 x 70</i> | | 14 | Power S2, Fr. or Wv. | <i>10 Fr.</i> |
| 5 | SAG 1, mm | <i>∞</i> | | 15 | Irreg. S2, Fr. or Wv. | <i>10 Fr.</i> |
| 6 | SAG 2, mm | <i>∞</i> | | 16 | Surface Quality / SD S2 | <i>60/40</i> |
| 7 | Center Thickness, mm | <i>10.000</i> | <i>±1.050</i> | 17 | TIR, mm | <i>50 microns</i> |
| 8 | Full Thickness, mm | <i>—</i> | | 18 | Wedge, mm | <i>—</i> |
| 9 | Radius S1, mm | <i>∞</i> | | 19 | | |
| 10 | Power S1, Fr. or Wv. | <i>.50 Fr.</i> | | 20 | | |
| | | | | ACTUAL (MEASURED) | | |
| | | | | Part Number | | |
| N | 1 | 2 | 3 | 4 | 5 | 6 |
| 1 | <i>94.96</i> | | | | | |
| 2 | <i>74.99</i> | | | | | |
| 3 | <i>90 x 70</i> | | | | | |
| 4 | <i>90 x 70</i> | | | | | |
| 5 | <i>∞</i> | | | | | |
| 6 | <i>∞</i> | | | | | |
| 7 | <i>9.85</i> | | | | | |
| 8 | <i>—</i> | | | | | |
| 9 | <i>∞</i> | | | | | |
| 10 | <i>.159 λ P-V see interferograms</i> | | | | | |
| 11 | <i>.023 λ rms " "</i> | | | | | |
| 12 | <i>< 60/40</i> | | | | | |
| 13 | <i>∞</i> | | | | | |
| 14 | <i>.229 λ P-V see interferograms</i> | | | | | |
| 15 | <i>.020 λ rms " "</i> | | | | | |
| 16 | <i>< 60/40 but not graded out.</i> | | | | | |
| 17 | <i>23 microns</i> | | | | | |
| 18 | <i>—</i> | | | | | |
| 19 | | | | | | |
| 20 | | | | | | |
| | | | | QC Inspector | | |

GPI Application
Surface/Wavefront Map

Sm Aperture Z490

MEASURE
Analyze
Mask Data
Save Data
Load Data
Calibrate
Reset

Analyze Ctrl

S/W Profile
Slope Mag
Slope X
Slope Y

PSE
MTE
MTF Profile
Zernikes

ISO 10110-S
SynthFringes
Measure Attr
Analyze Attr
Process
Report
Units
Video Monitor

Z490

Oblique Plot

mm
+0.000051
-0.000050
pix
39 264 24

Removed: PST TLT PWR
Aperture OD (#):
Aperture ID (#):
Trimmed: 1
Filter: Off

Z490

Measurement Controls

Comment: Esd. Sil. Min., 95 X 75 mm Rect.
Part Number: 10448 Rev.B
Min. Mod Pct: 7
Fold Flat
Augs: 0
Phase Aves: 5
Instrument: Mark GPI Id 0 SN 4624 SE 0

Z490

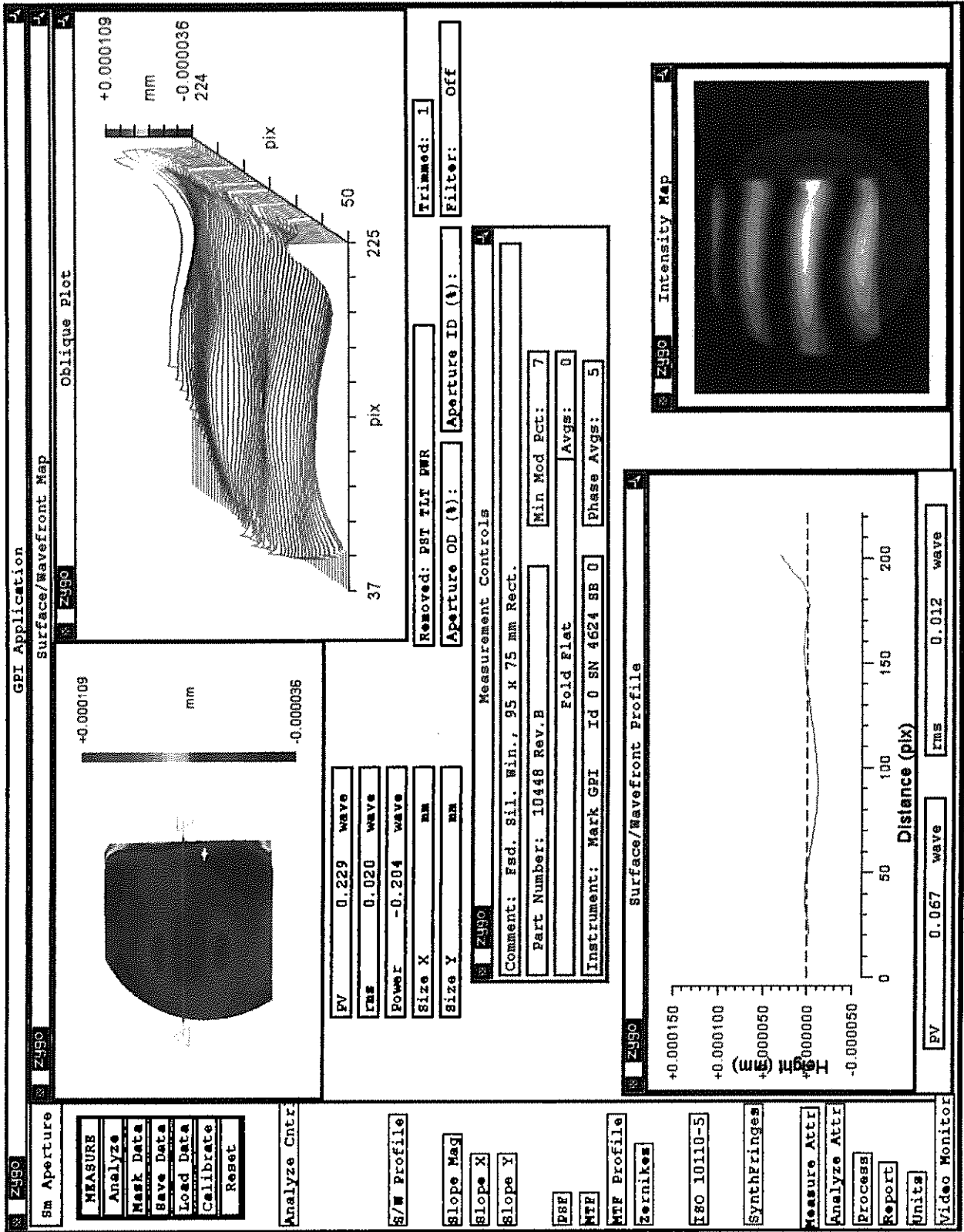
Surface/Wavefront Profile

Height (µm)
Distance (pix)
0 50 100 150 200
+0.000100
+0.000050
0
-0.000050
-0.000100

EV 0.075 wave Eps 0.022 wave

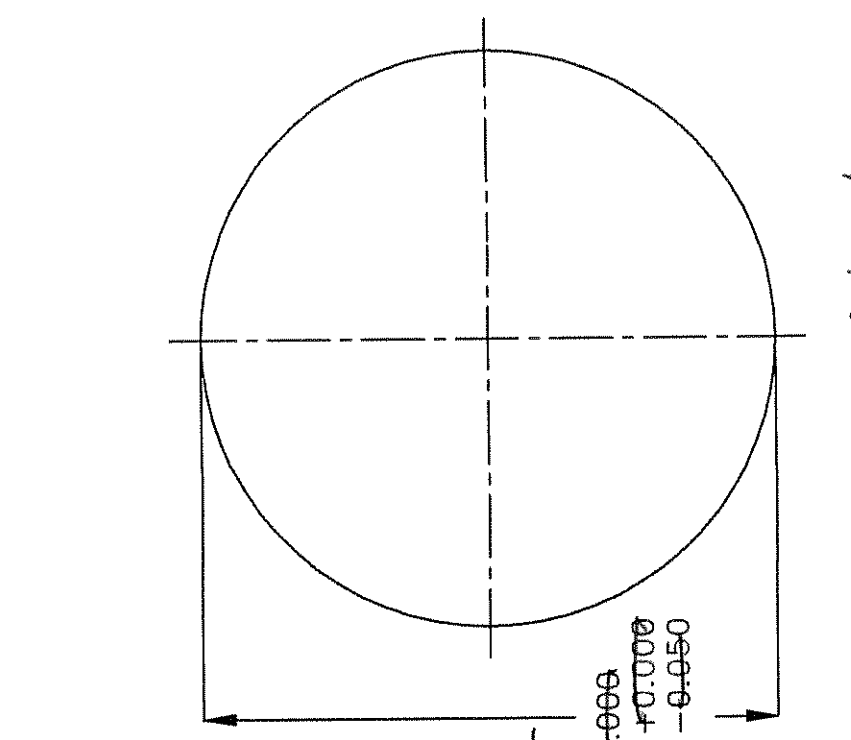
Arrow (A) on edge points toward surface 1

Roland - Originally this was surface 1 but surface quality was poor so I flipped it over and polished the other side. This is flatness of back surface.

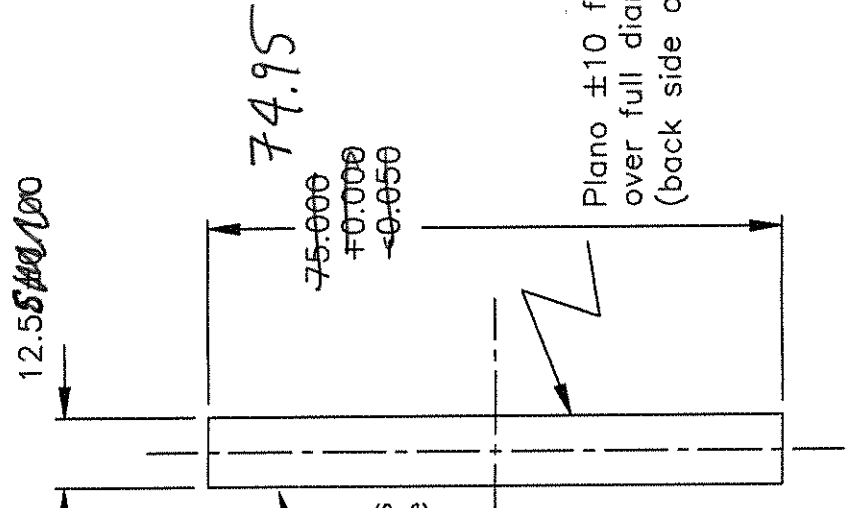


Arrow (A) on edge points toward surface
Back surface is flat within 3 fringes.

| REVISIONS | | DATE | REVISION BY | APPROVED |
|-----------|-------------|------|-------------|----------|
| LTR | DESCRIPTION | | | |



As Delivered



12.58 mm
 Plano ±1/2 fringes over clear aperture

74.95
 ±0.000
 -0.050
 Plano ±10 fringes over full diameter (back side of optic)

NOTES:

- 1) Dimensions are in millimeters
- 2) Polished to full diameter
- 3) Optical Surface: < 16.65nm rms figure
- 4) Wedge < 0.038 degrees (JIR 50µm) 0.028°
- 5) Clear aperture - 70.0 mm diameter
- 6) Pure gold coating for 1-5 µm high reflectivity
- 7) Bevel all edges with 0.5mm face width max by 45 degrees
- 8) Scratch and dig spec: 60/40 per mil-0-13830A
- 9) All surface dimensions are at standard temperature and pressure
- 10) Request inspection report based on final data

CONTACT: ROLAND SARLOT 520-626-7252

Steward Observatory, University of Arizona
 933 N. Cherry Avenue, Tucson, AZ 85721 (520)621-7859

| | | | | | |
|--|-------------------|--------------------------|----------------------------------|--|----------------|
| DESIGNED BY: R. SARLOT | DATE: 05/08/98 | CHECKED BY: R. SARLOT | DATE: 05/19/99 | PROJECT: ARIES-Az. Infrared Echelle Spectro. | REVISION: A |
| TOLERANCES UNLESS OTHERWISE SPECIFIED: | | | | TITLE: Mirror at Spectrometer Pupil For reflective channel imaging | |
| DECIMALS | FRACTIONS | ANGLES | DRAWING NUMBER: 10578 | | |
| XXX | XX | | SCALE: None | | |
| DIMENSIONS ARE IN: ENGLISH METRIC | | | ACTIVITY CODE: | | |
| MATERIAL: Fused Silica | | | CURRENT TIME/DATE/FILE LOCATION: | | |
| FINISH | | | FILE ARCHIVE LOCATION: | | |

Mirror

| | | | | INSPECTION DATA | | |
|-----------------------------|-------------------------------|--------------------------|--------------------------|------------------------------|-------------------------|---------------------|
| Customer PON <i>P252602</i> | | | | WO# <i>1300-01</i> | PN <i>4506</i> | Date |
| Full Quantity <i>1</i> | | Quantity Tested <i>1</i> | | Material <i>Fused Si/ica</i> | <i>10578 A</i> | Lot # <i>1</i> |
| Parameter | | Specifications | | Parameter | | Specifications |
| N | | NOM | TOL | N | NOM | TOL |
| 1 | Diameter or Length | <i>75.00</i> | <i>+ .000 - .050</i> | 11 | Irreg. S1, Fr. or Wv. | <i>16.65 nm rms</i> |
| 2 | Width | | | 12 | Surface Quality / SD S1 | <i>60/40</i> |
| 3 | Clear Aperture 1, mm | <i>70.00</i> | | 13 | Radius S2, mm | <i>∞</i> |
| 4 | Clear Aperture 2, mm | <i>70.00</i> | | 14 | Power S2, Fr. or Wv. | <i>10 Fr.</i> |
| 5 | SAG 1, mm | <i>—</i> | | 15 | Irreg. S2, Fr. or Wv. | <i>10 Fr.</i> |
| 6 | SAG 2, mm | <i>—</i> | | 16 | Surface Quality / SD S2 | <i>60/40</i> |
| 7 | Center Thickness, mm | <i>12.50</i> | <i>± .100</i> | 17 | TIR, mm | <i>50 microns</i> |
| 8 | Full Thickness, mm | <i>—</i> | | 18 | Wedge, mm | |
| 9 | Radius S1, mm | <i>∞</i> | | 19 | | |
| 10 | Power S1, Fr. or Wv. | <i>.50 Fr</i> | | 20 | | |
| | | | | ACTUAL (MEASURED) | | |
| | | | | Part Number | | |
| N | 1 | 2 | 3 | 4 | 5 | 6 |
| 1 | <i>74.95</i> | | | | | |
| 2 | <i>—</i> | | | | | |
| 3 | <i>70.00</i> | | | | | |
| 4 | <i>70.00</i> | | | | | |
| 5 | <i>—</i> | | | | | |
| 6 | <i>—</i> | | | | | |
| 7 | <i>12.55</i> | | | | | |
| 8 | <i>—</i> | | | | | |
| 9 | <i>—</i> | | | | | |
| 10 | <i>.123 λ P-V</i> | <i>see interferogram</i> | | | | |
| 11 | <i>.019 λ rms</i> | <i> </i> | <i> </i> | | | |
| 12 | <i>< 60/40</i> | | | | | |
| 13 | <i>—</i> | | | | | |
| 14 | <i>.448 λ P-V</i> | <i>see interferogram</i> | | | | |
| 15 | <i>.448 λ P-V</i> | <i> </i> | <i> </i> | | | |
| 16 | <i>< 60/40</i> | | | | | |
| 17 | <i>37 microns</i> | | | | | |
| 18 | | | | | | |
| 19 | | | | | | |
| 20 | | | | | | |

QC Inspector

GPI Application

Sm Aperture: Z490 Surface/Wavefront Map Oblique Plot

MEASURE Analyze Mask Data Save Data Load Data Calibrate Reset

Measure Cntr. Analyze Cntr.

S/W Profile

Slope Mag

Slope X

Slope Y

PBF

ATF

MTF Profile

Zernikes

ISO 10110-5

SynthEringes

Analyze Attri

Process

Report

Units

Video Monitor

Z490

EV 0.123 wave

RMS 0.019 wave

Power -0.048 wave

Size X 69.7 mm

Size Y 69.7 mm

Removed: Pst Tlt Pwr

Aperture OD (%):

Trimmed: 1

Filter: Off

Z490

Intensity Map

Z490

Surface/Wavefront Profile

EV 0.079 wave

RMS 0.020 wave

Z490

Measurement Attributes

Wed Dec 01 08:23:26 1999

Data Sign: Normal

Esd. Sil. Win., 75 dia. x 12.5

Scale Factor: 0.5

S/N: 10578 rev A

Camera Res: 433.0 um

Spectrometer Pupil, Surface 1

Oblique Plot

mm

28 99 15

+0.000047 mm

-0.000031 86

Surface/Wavefront Profile

Distance (mm)

+0.000060

+0.000035

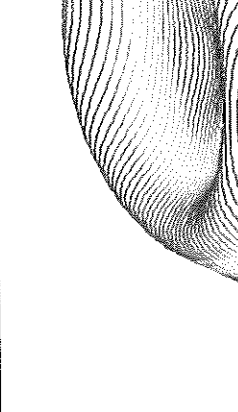
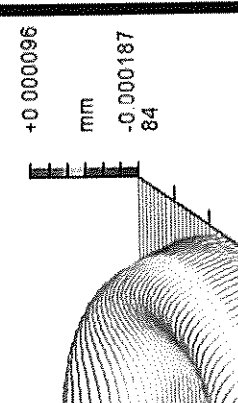
+0.000010

0.000015

-0.000040

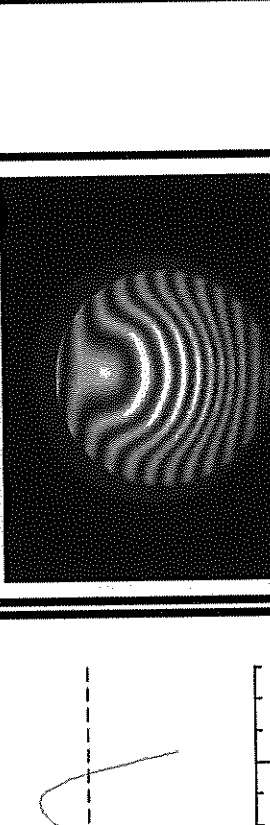
0 20 40 60 80

Arrow (A) on edge points toward Surface 1



| | | |
|--------|-------|------|
| PV | 0.448 | wave |
| RMS | 0.095 | wave |
| Power | 1.472 | wave |
| Size X | 69.3 | mm |
| Size Y | 69.3 | mm |

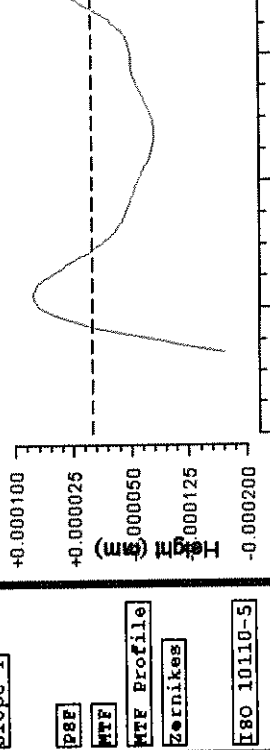
Removed: PSY TLT PWR Trimmed: 1
 Aperture OD (%): Aperture ID (%): Filter: Off



| | | |
|-----|-------|------|
| PV | 0.390 | wave |
| rms | 0.087 | wave |

Surface/Wavefront Profile
 Measurement Attributes
 Wed Dec 01 08:28:28 1999 Data sign: Normal
 Fsd. Sil. Win., 75 dia. x 12.5 Scale Factor: 0.5
 S/N: 10578 rev A Camera Res: 430.5 um

Z990 Intensity Map



- MEASURE
- Analyze
- Mask Data
- Save Data
- Load Data
- Calibrate
- Reset

Measure Cntr

Analyze Cntr

S/M Profile

Slope Mag

Slope X

Slope Y

PSF

MTF

MTF Profile

Zernikes

ISO 10110-5

SynthFringes

Analyze Attr

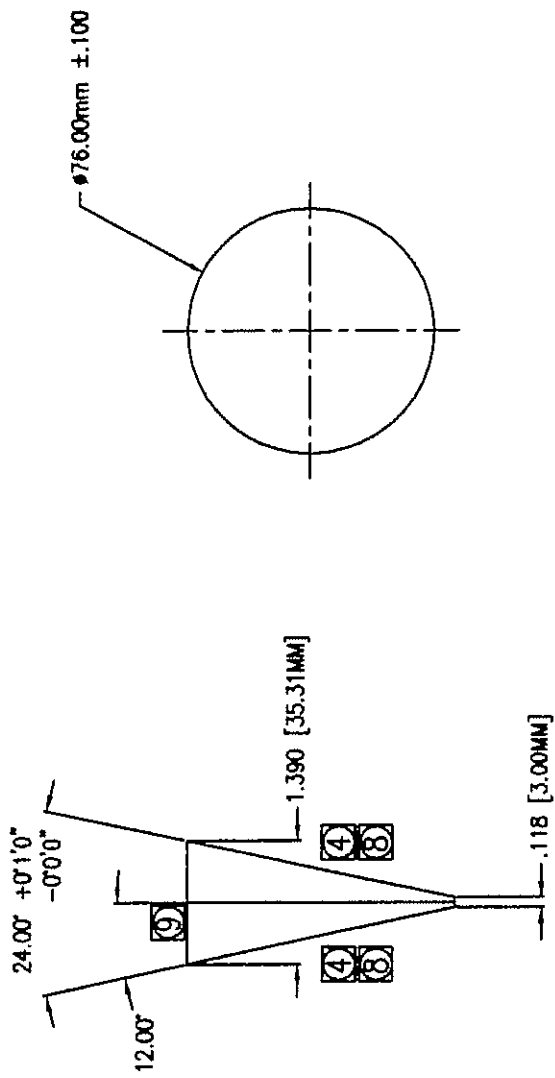
Process

Report

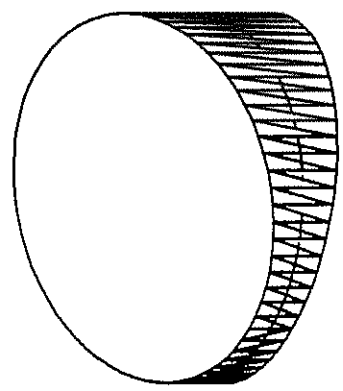
Unit#

Video Monitor

| | | | |
|--------------------------------|---------|---------|-------------|
| UN | REVISED | DATE | DESIGNED BY |
| 8 | | 1/22/92 | SAW |
| Change to Mirror Specification | | | |



- NOTES:
- 1) Dimensions are in inches (millimeters in parenthesis)
 - 2) Material: Silicon $n(10.60\mu m) = 3.4176 \pm 5 \times 10^{-6}$
 Grain boundary free
 No visible inclusions
 Polished to full diameter
 - 3) Optical Surfaces:
 Figure < 0.031 waves rms (waves = $632.8nm$)
 Flatness $< \lambda/20$ peak-to-valley ($\lambda = 632.8nm$)
 Micro roughness/finish $< 10A$ rms
 Pitch polish to edges
 - 5) Clear aperture -- 68.5mm
 - 6) Bevel all edges with 0.5mm face width max by 45 degrees
 - 7) All surface dimensions are at standard temperature and pressure
 - 8) Anti-reflection coating for 1.1um to 5.5um --Not yet specified
 Must withstand 77K operating temperature
 - 9) Mark base of optic, 180° from apex (ie. mark the maximum point of wedge)
 - 10) Request inspection report based on final data
 - 11) For any misunderstandings in drawing, please call Roland Sorlot



| | | | |
|---|-------------------|--|----------------|
| Q3 USE SCALE DRAWING TOLERANCES UNLESS OTHERWISE SPECIFIED UNLESS INDICATED OTHERWISE | | CONTACT: Roland Sorlot 500-626-7252 | |
| DRAWING NO. 177292-001 DATE 1/22/92 | | Steward Observatory, University of Arizona 933 N. Cherry Avenue, Tucson, AZ 85721 (520)921-7600 | |
| DRAWN BY: SAW CHECKED BY: SAW | DATE: 1/22/92 | PROJECT: ARIES-Az. Infrared Echelle Spectro. | PART NO: 12193 |
| TITLE: Echelle Cross Dispersing Prism | MATERIAL: Silicon | FINISH: | C |

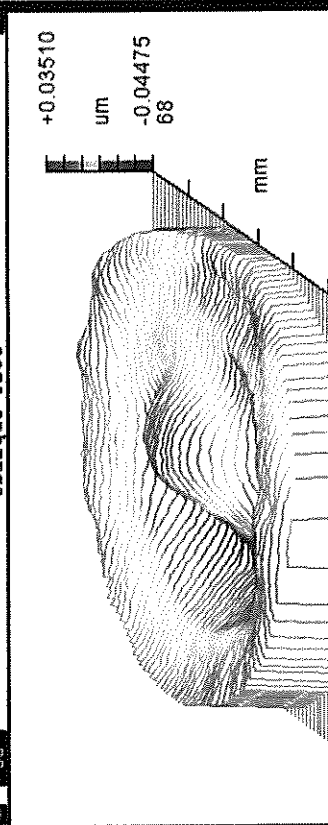
PRISM

| | | | | INSPECTION DATA | | |
|-----------------------------|---|--------------------------|------------------|--------------------|------------------------------|-------------------|
| Customer PO# <i>P620885</i> | | | | WO# <i>1496-01</i> | PN <i>4668</i> | Date <i>6-1-2</i> |
| Full Quantity <i>1</i> | | Quantity Tested <i>1</i> | | Material <i>Si</i> | CPN <i>12193</i> | Lot# <i>1</i> |
| N | Parameter | Specifications | | N | Specifications | |
| | | NOM | TOL | | NOM | TOL |
| 1 | Diameter or Length | <i>76.00</i> | <i>+/- .10</i> | 10 | Radius S2, mm | <i>∞</i> |
| 2 | Width | <i>—</i> | | 11 | SAG 2, mm | <i>—</i> |
| 3 | Center ^{Edge} Thickness, mm | <i>35.31</i> | <i>high side</i> | 12 | Power S2, Fr. or Wv. | <i>—</i> |
| 4 | Radius S1, mm | <i>∞</i> | | 13 | Irreg. S2, Fr. or <u>Wv.</u> | <i>.033 rms</i> |
| 5 | SAG 1, mm | <i>—</i> | | 14 | Surface Quality / SD S2 | <i>60/40</i> |
| 6 | Power S1, Fr. or Wv. | <i>—</i> | | 15 | Clear Aperture 2, mm | <i>60.80</i> |
| 7 | Irreg. S1, Fr. or <u>Wv.</u> | <i>.033</i> | <i>rms</i> | 16 | TIR, mm | <i>—</i> |
| 8 | Surface Quality / SD S1 | <i>60/40</i> | | 17 | Wedge, mm | <i>24° +/- 1'</i> |
| 9 | Clear Aperture 1, mm | <i>60.80</i> | | 18 | Coating | <i>None</i> |
| ACTUAL (MEASURED) | | | | | | |
| Part Number | | | | | | |
| N | 1 | 2 | 3 | 4 | 5 | 6 |
| 1 | <i>75.97</i> | | | | | |
| 2 | <i>—</i> | | | | | |
| 3 | <i>35.30</i> | | | | | |
| 4 | <i>∞</i> | | | | | |
| 5 | <i>—</i> | | | | | |
| 6 | <i>—</i> | | | | | |
| 7 | <i>.024 wv. rms</i> | | | | | |
| 8 | <i>< 60/40</i> | | | | | |
| 9 | <i>60.80</i> | | | | | |
| 10 | <i>∞</i> | | | | | |
| 11 | <i>—</i> | | | | | |
| 12 | <i>—</i> | | | | | |
| 13 | <i>.026 wv. rms</i> | | | | | |
| 14 | <i>< 60/40</i> | | | | | |
| 15 | <i>60.80</i> | | | | | |
| 16 | <i>—</i> | | | | | |
| 17 | <i>24° 0' 20"</i> | | | | | |
| 18 | <i>None</i> | | | | | |

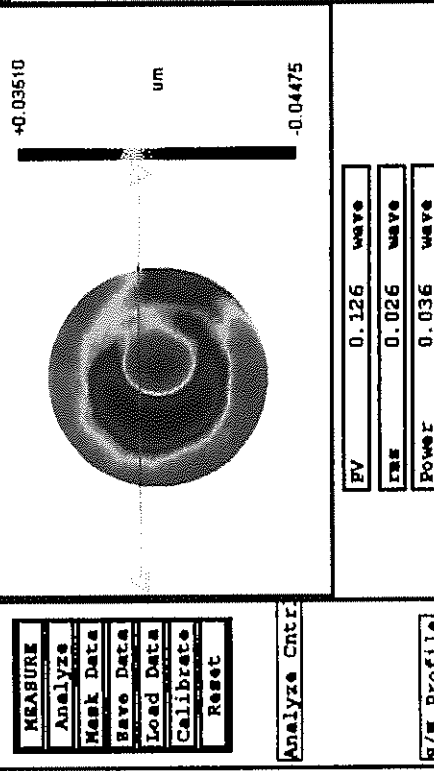
Note: "A" points toward high point of wedge.

QC Inspector

Sm Aperture 2990 2990 Oblique Plot



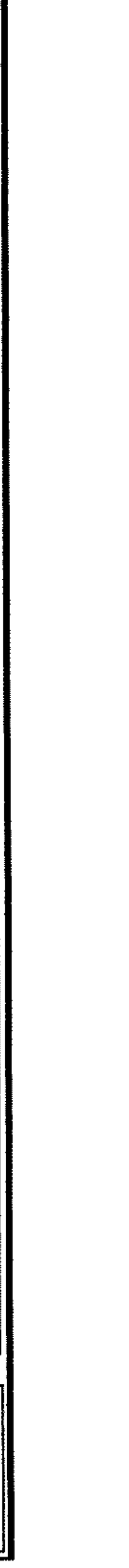
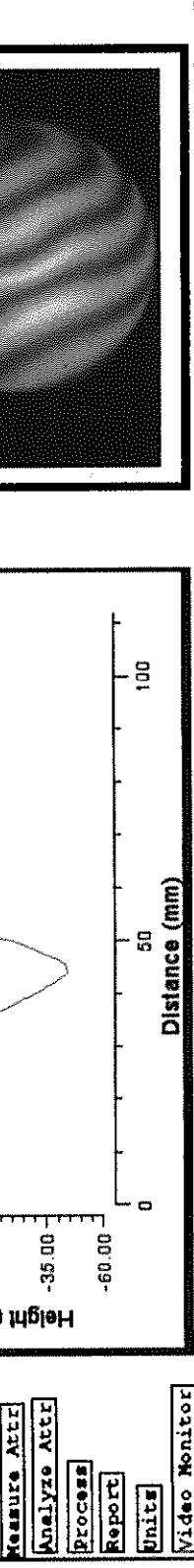
| | | |
|-------|-------|------|
| FV | 0.126 | wave |
| rms | 0.026 | wave |
| Power | 0.036 | wave |

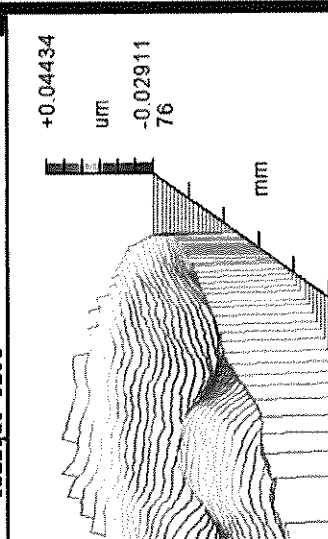


Removed: PST TLT Trimmed: 0
 Aperture OD (mm): 80 Aperture ID (mm): 0 Filter: Off

Measurement Controls
 Comment: U of A Silicon Echelle Cross Dispersing Prism Surface 2
 Drawing Number: 12193 Phase Res: High
 Purchase Order Number: P620885 AGC: On
 Instrument: Mark GPI Id 0 SN 4624 SB 0 Phase Avgs: 0
 Data Sign: Normal Intens Avgs: 0

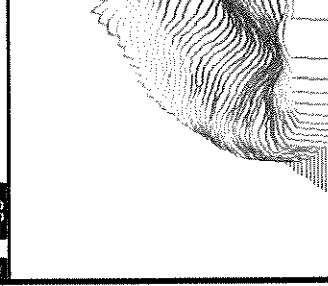
ISO 10110-5
 Zernikes
 MTF Profile
 MTF
 PSF
 Slope Y
 Slope X
 Slope Mag
 S/W Profile
 Analyze Cntrl
 Reset
 Calibrate
 Load Data
 Save Data
 Mask Data
 Analyze
 MEASURE





Removed: PSF ELI Trimmed: 0

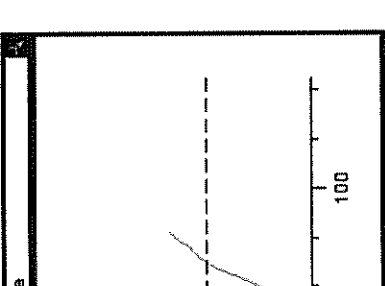
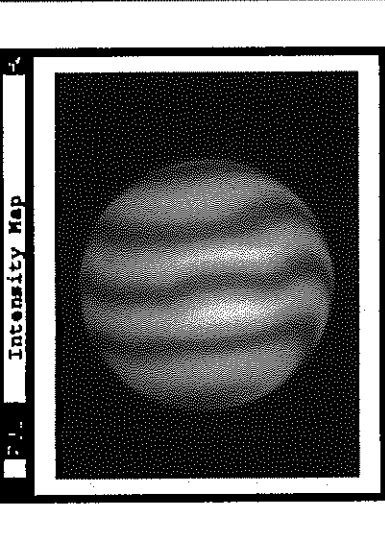
Aperture OD (%): 80 Aperture ID (%): 0 Filter: Off



FV 0.116 wave
rms 0.024 wave
Power 0.047 wave

Measurement Controls

Comment: U of A Silicon Echelle Cross Dispersing Prism Surface 1
 Drawing Number: 12193 Phase Res: High
 Purchase Order Number: P620885 AGC: On
 Instrument: Mark GPI Id 0 SN 4624 88 0 Phase Avgs: 0
 Data Sign: Normal Intens Avgs: 0



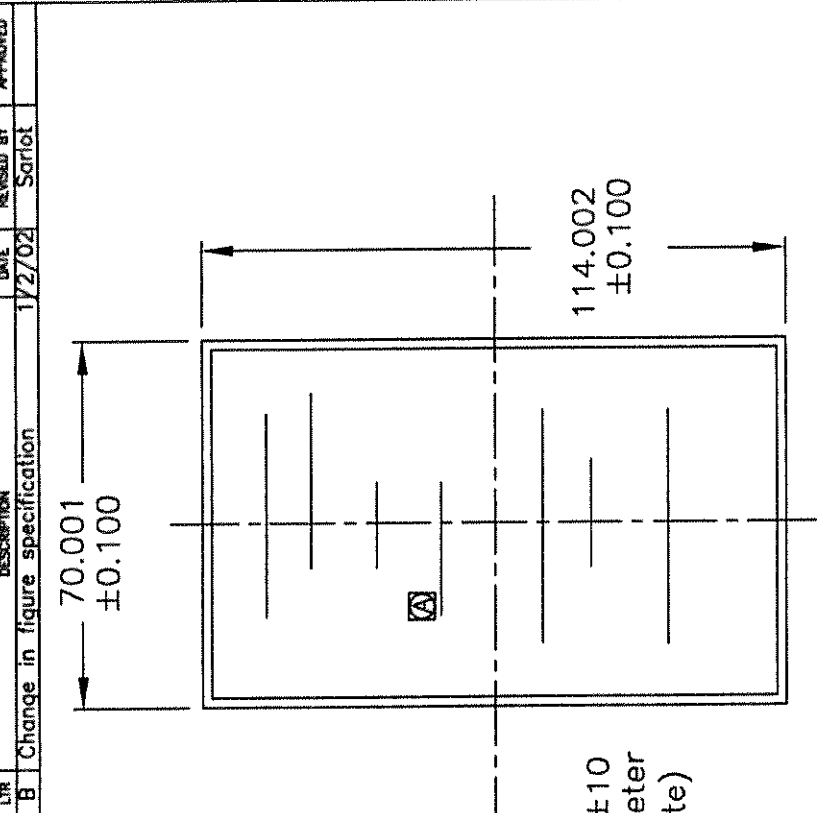
- MEASURE
 - Analyze
 - Mask Data
 - Save Data
 - Load Data
 - Calibrate
 - Reset
- Analyze Cntrl

- S/W Profile
- Slope Mag
- Slope X
- Slope Y

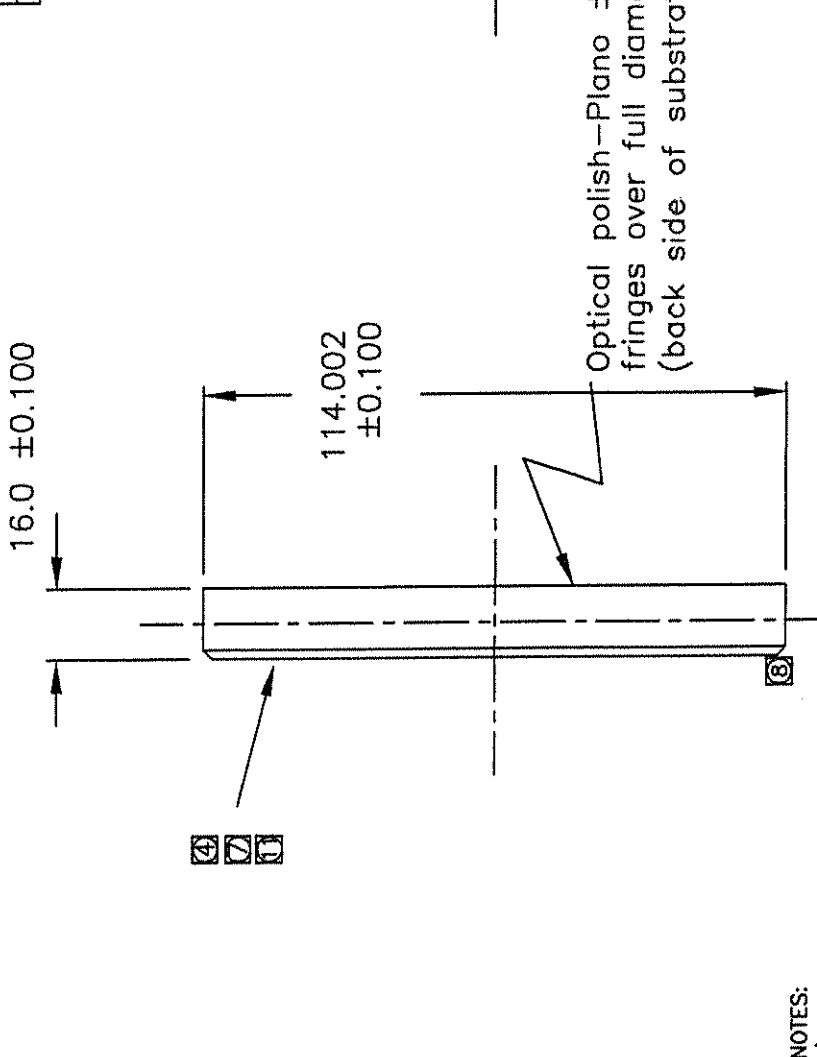
- PSF
- MTF
- MTF Profile
- Kernikes

- I/O 10110-S
- SynthFringes
- Measure Attr
- Analyze Attr
- Process
- Report
- Units
- Video Monitor

| REVISIONS | | |
|-----------|--------------------------------|--------------------|
| LTR | DESCRIPTION | DATE |
| B | Change in figure specification | 1/2/02 |
| | | Revised By: Sarlot |
| | | Approved: |



| | | | |
|--|-------------------|---|---|
| | | CONTACT: ROLAND SARLOT 520-626-7252 Steward Observatory, University of Arizona 933 N. Cherry Avenue, Tucson, AZ 85721 (520)621-7659 | |
| DESIGNED BY: R. SARLOT | DATE: 05/08/98 | PROJECT: ARIES-Az. Infrared Echelle Spectro. | TITLE: Echelle Grating Substrate |
| DRAWN BY: R. SARLOT | CHECKED BY: | PROJECT: ARIES-Az. Infrared Echelle Spectro. | TITLE: 30,000 Resolution Diffraction Grating |
| APPROVED: | APPROVED: | PROJECT: ARIES-Az. Infrared Echelle Spectro. | TITLE: Echelle Grating Substrate |
| APPROVED: | APPROVED: | PROJECT: ARIES-Az. Infrared Echelle Spectro. | TITLE: 30,000 Resolution Diffraction Grating |
| APPROVED: | APPROVED: | PROJECT: ARIES-Az. Infrared Echelle Spectro. | TITLE: Echelle Grating Substrate |
| JOB NO. | ACTIVITY CODE | PLAT SIZE | SCALE |
| | | A | None |
| | | | DRAWING NUMBER: 10487 |
| | | | REVISION: C |
| CURRENT TIME/DATE/FILE LOCATION: E:\Production\ARIES\PART 06/23/98 11:18 FILE ARCHIVE LOCATION: | | | |



- UNLESS OTHERWISE SPECIFIED
TOLERANCES ON:
- | | | |
|----------|-----------|--------|
| DECIMALS | FRACTIONS | ANGLES |
| .XX | XX | |
| AS NOTED | | |
- DIMENSIONS ARE IN:
ENGLISH _____ METRIC
- MATERIAL:
Fused Silica
- FINISH
- NOTES:
- Dimensions are in millimeters
 - Material: Fused Silica (Grain boundary free, no inclusions nor bubbles on optical surface)
 - Polished to full diameter
 - Optical Surface:
Figure < 0.035 waves rms in littrow measurement (wavelength = 632.8nm)
Require interferometric image
Flatness < lamda/5 peak-to-valley over clear aperture (lamda=632.8nm)
Micro roughness/finish < 10A rms
 - Wedge < (TIR 100um)
 - Clear aperture - 50.0 mm diameter x 110.0 mm diameter
 - Grating surface
Richardson Echelle Grating #35-13-*--412
23.2 grooves per mm, 63 degree blaze angle
Operating temperature at 77 Kelvin
Specific cryo epoxy instructions must be observed
 Representation of ruling direction
 - Bevel all edges with 1.5mm face width max by 45 degrees
 - All surface dimensions are at standard temperature and pressure
 - Indicate optical surface with scribe on side of optic
 - Pure gold coating for 1-5um high reflectivity
 - Request inspection report based on final data
 - For any misunderstandings in drawing, please contact Roland Sarlot

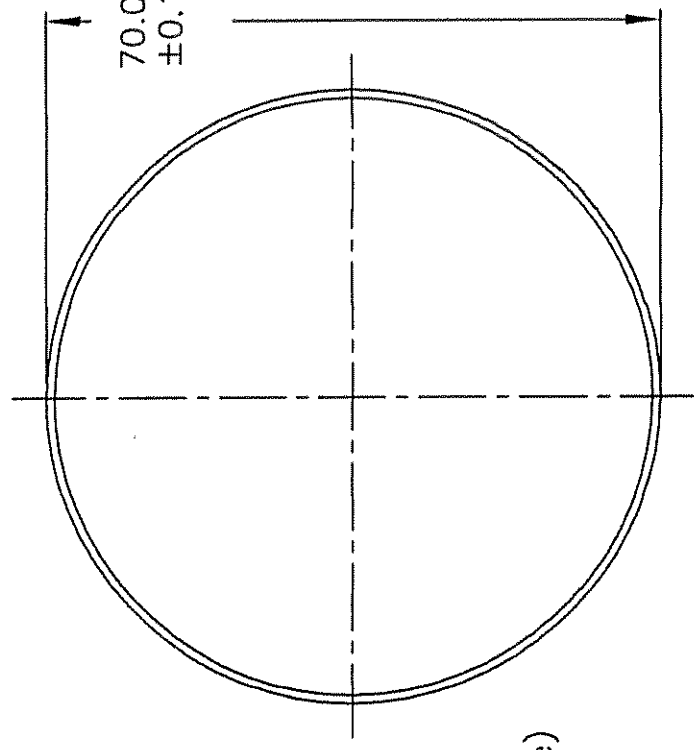
| REVISIONS | | | |
|-----------|--------------------------------|----------|------------|
| LTR | DESCRIPTION | DATE | REVISED BY |
| A | Change in figure specification | 10/17/01 | Sarlot |

10.0 +0.000
-0.100

70.00
±0.100

70.00
±0.100

Plano ±10 fringes
over full diameter
(back side of substrate)



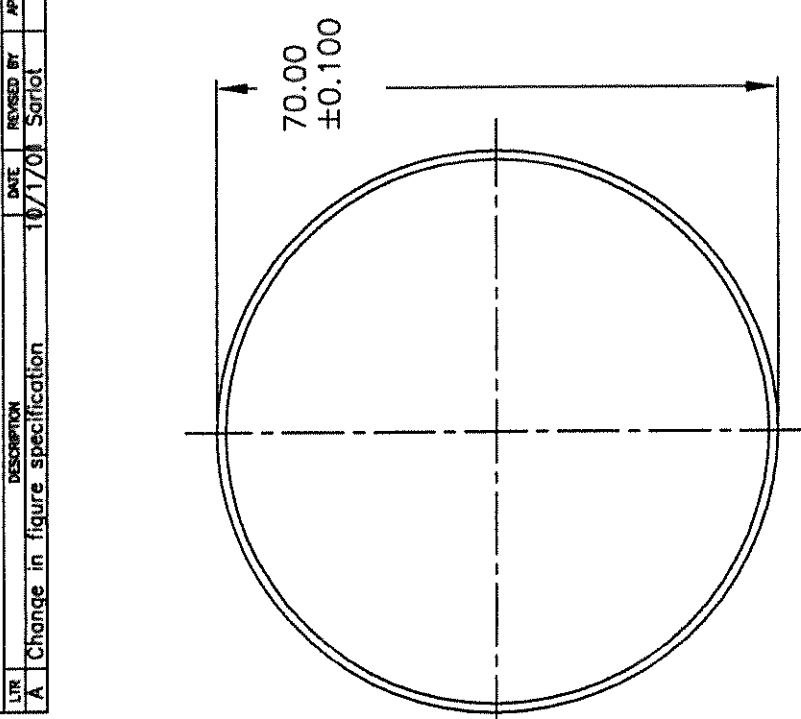
- NOTES:
- Dimensions are in millimeters.
 - Material: Fused Silica (Grain boundary free, no inclusions nor bubbles on optical surface)
 - Polished to full diameter
 - Optical Surface:
 - Figure < 0.0574 waves rms in Littrow measurement (wavelength = 632.8nm)
 - Require interferographic image
 - Flatness < lamda/5 peak-to-valley (lamda=632.8nm)
 - Micro roughness/finish < 10A rms
 - Wedge < (TIR 100um)
 - Clear aperture - 63.0 mm diameter
 - Grating surface
 - Richardson Grating #35-53-*--932
 - 40.0 grooves per mm, 17.5 degree blaze angle
 - 15.0um nominal 1st order littrow wavelength
 - Operating temperature at 77 kelvin
 - Specific cryo epoxy instructions must be observed
 - Bevel all edges with 1.5mm face width max by 45 degrees
 - All surface dimensions are at standard temperature and pressure
 - Indicate optical surface & groove direction with scribe on optic edge
 - Pure gold coating for 1-5um high reflectivity
 - Request inspection report based on final data
 - For any misunderstandings in drawing, please call Roland Sarlot

CONTACT: ROLAND SARLOT 520-626-7252
Steward Observatory, University of Arizona
933 N. Cherry Avenue, Tucson, AZ 85721 (520)621-7859

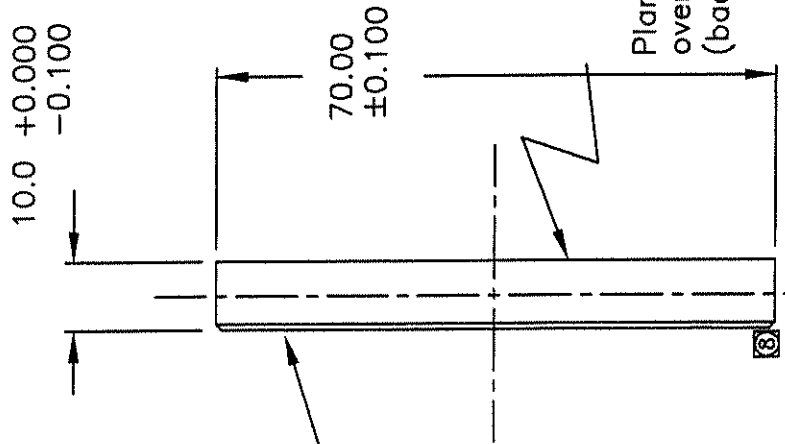
| | | |
|---------------------------|------------------|--|
| DESIGNED BY: R. SARLOT | DATE: 2/12/01 | CATEGORY: |
| DRAWN BY: R. SARLOT | 2/12/01 | PROJECT: ARIES-Az. Infrared Echelle Spectro. |
| CHECKED BY: | | TITLE: LM Grating Substrate 4,400 Resolution Diffraction Grating |
| APPROVED: | | PLOT SIZE: SCALE: None |
| APPROVED: | | DRAWING NUMBER: 12192 |
| APPROVED: | | REVISION: B |
| JOB NO. | ACTIVITY CODE | FILE ARCHIVE LOCATION: E:\Vehementer\JUSC\4171 DR\23/08 11:18 |

| | | | |
|----------------------------|----------------------|----------------|--------|
| UNLESS OTHERWISE SPECIFIED | DECIMALS | FRACTIONS | ANGLES |
| TOLERANCES ON: | XXX AS NOTED | XX AS NOTED | |
| DIMENSIONS ARE IN: | ENGLISH - METRIC - X | | |
| MATERIAL | Fused Silica | | |
| FINISH | 2 | | |

| REVISIONS | | |
|-----------|--------------------------------|----------|
| LTR | DESCRIPTION | DATE |
| A | Change in figure specification | 10/17/01 |
| | | Sariot |
| | | APPROVED |



Plano ±10 fringes
over full diameter
(back side of substrate)



- NOTES:
- 1) Dimensions are in millimeters
 - 2) Material: Fused Silica (grain boundary free, no inclusions nor babbles on optical surface)
 - 3) Polished to full diameter
 - 4) Optical Surface:
 - Figure <math>< \lambda / 5</math> waves rms in Littrow measurement (waves = 632.8nm)
 - Require interferographic image
 - Flatness <math>< \lambda / 5</math> peak-to-valley (lambda=632.8nm)
 - Micro roughness/finish <math>< 10\text{Å}</math> rms
 - 5) Wedge <math>< (TIR 100\mu\text{m})</math>
 - 6) Clear aperture - 63.0 mm diameter
 - 7) Grating surface
 - Richardson Grating #35-53-*--856
 - 75.0 grooves per mm, 10 degree blaze angle
 - 4.65um nominal 1st order Littrow wavelength
 - Operating temperature at 77 kelvin
 - Specific cryo epoxy instructions must be observed
 - 8) Bevel all edges with 1.5mm face width max by 45 degrees
 - 9) All surface dimensions are at standard temperature and pressure
 - 10) Indicate optical surface & groove direction with scribe on optic edge
 - 11) Pure gold coating for 1-5um high reflectivity
 - 12) Request inspection report based on final data
 - 13) For any misunderstandings in drawing, please call Roland Sariot

| | | | |
|---|----------------|------------------------|--|
| DESIGNED BY: R. SARLOT | | DATE: 2/12/01 | CONTACT: ROLAND SARLOT 520-626-7252 |
| DRAWN BY: R. SARLOT | | 2/12/01 | Steward Observatory, University of Arizona |
| CHECKED BY: | | | 933 N. Cherry Avenue, Tucson, AZ 85721 (520)821-7659 |
| APPROVED: | | | PROJECT: ARIES-Az. Infrared Echelle Spectro. |
| APPROVED: | | | TITLE: JHK Grating Substrate |
| APPROVED: | | | 3,000 Resolution Diffraction Grating |
| JOB NO. | ACTIVITY CODE: | PLAT SIZE SCALE: | ORDER NUMBER: |
| | | A None | 12191 |
| CURRENT FILE/DWG/FILE LOCATION: E:\Users\rsariot\My Documents\1012191.dwg | | FILE ARCHIVE LOCATION: | |

| | |
|----------------------------|--------------|
| UNLESS OTHERWISE SPECIFIED | FINISH |
| TOLERANCES ON: | |
| DIMENSIONS ARE IN: | |
| ENGLISH METRIC | |
| MATERIAL: | Fused Silica |
| OTHER: | |

Inspection Report

Part Name: Reflective Camera Mirror 1 Ellipse

Drawing: 10443 rev. D

Date Issued: 3/7/99

Date Completed: 6/15/02

Account #: 433815

Unit: AMM

Reporting: R. Ceragioli

Proc #: P0009 & P0026

| | |
|---|--|
| Parent body center thickness | = 11.86 +/- 0.01mm (digital height gauge) |
| Parent body edge thickness | = 43.90 +/- 0.03mm (caliper) |
| Parent body wedge error | = 0.01 +/- 0.005mm (dial indicator) |
| Finished part center thickness | = 25.98 25.02 mm (derived quantity) |
| Short conjugate length | = 371.5 +/- 0.05mm (micrometer) |
| Long conjugate length | = 4810 +/- 5mm (tape) |
| ROC | = 689.7mm (derived quantity) |
| Conic constant | = -0.7338 (derived quantity) |
| Figure error of optic before cutting | = 41nm RMS over finished part size (Shack-cube interferometer) |
| Figure error of flat back surface | <10 fringes (6" ULE reference flat) |
| N.B. See drawing for following quantities. | |
| Length of sides from 1-3 | = 125.928 +/- 0.005mm (CMM) |
| Length of sides from 2-4 | = 125.946 +/- 0.005mm (CMM) |
| Parallelism of sides 1 and 3 | = 0.016 +/- 0.005mm (CMM) |
| Parallelism of sides 2 and 4 | = 0.010 +/- 0.005mm (CMM) |
| Perpendicularity of 1-2 | = 0.020 +/- 0.005mm (CMM) |
| " " " " 2-3 | = 0.004 +/- 0.005mm (CMM) |
| " " " " 3-4 | = 0.001 +/- 0.005mm (CMM) |
| " " " " 4-1 | = 0.017 +/- 0.005mm (CMM) |
| Distance of crosshair to side 1 | = 62.98 +/- 0.03mm (caliper) |
| Distance of crosshair to side 2 | = 62.99 +/- 0.03mm (caliper) |
| Distance of crosshair to side 3 | = 62.95 +/- 0.03mm (caliper) |
| Distance of crosshair to side 4 | = 63.01 +/- 0.03mm (caliper) |

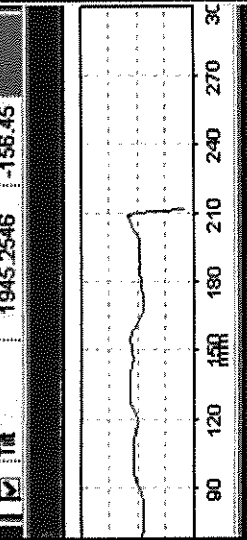
Remove Ref Piston TR Power Astig Coma Sph Sum Asym Blas Invert Morph

FV 284.0 mm RMS 41.29 mm

OPD Phase Ref Mod Shift Intensity Stop Frame S Comp D F

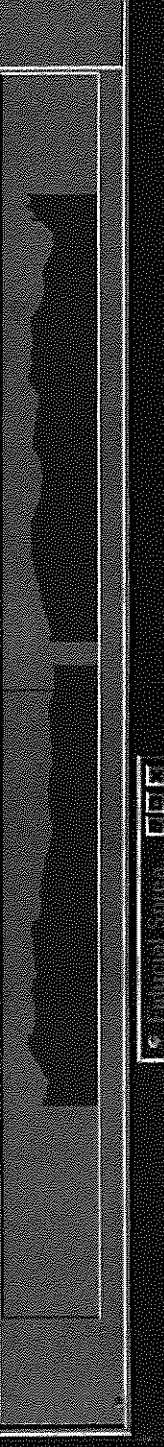
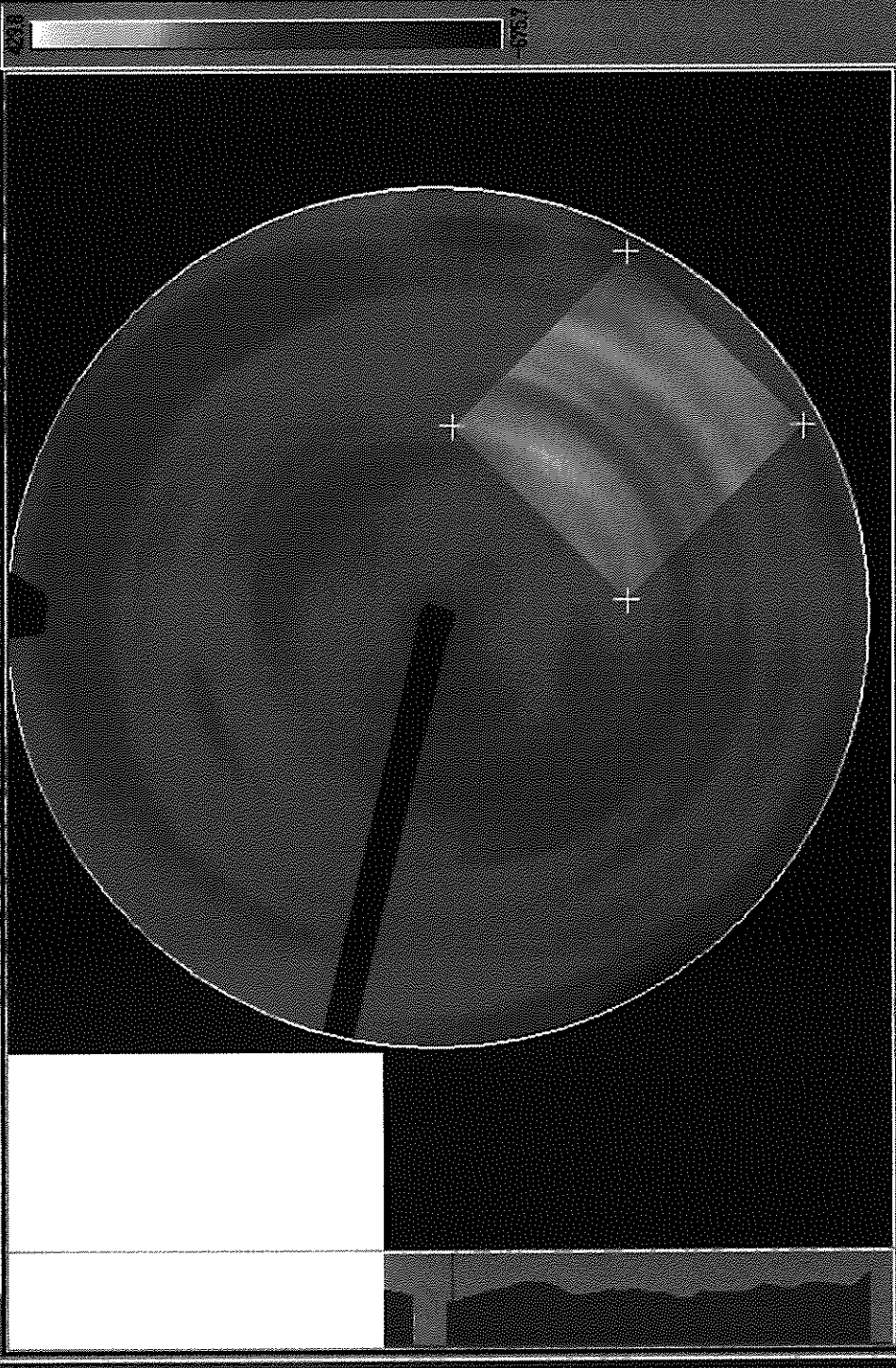
OPD Map [1:1]

| Name | Value | Angle |
|--|-----------|---------|
| <input checked="" type="checkbox"/> Tilt | 1945.2546 | -158.45 |



NO DATA

NO DATA



Inspection Report

Part Number:
10445

Part Name:
Reflective Camera Mirror 3

Date:
12-Jan-01

| Parameter | Specification: | Measured Value | Method of measurement: |
|--------------------------------------|--|----------------------------------|---|
| Dimensions | 160.002 x 120.002 +/- 0.05mm rectangular | 160.09 x 120.00 | Vernier Caliper |
| Radius | 407.201 +/- 0.200mm | 407.09 mm | Ronchi grating at Center of curvature measured with steel tape. |
| Conic | 0.00 (spherical) | 0 | Optical test setup - center of curvature. |
| Center Thickness | 25.400 +/- 0.050mm | 25.45 mm | Caliper |
| Wedge | <0.0036° x 0.0048° (10μ tir) | 9.4 +/- 2.6μl See Notes | Surface runout measured on air bearing. Edge thickness measured after cutting. |
| Clear Aperture | 120 x 115 mm min | 120 x 115 mm min | Defined as mask for optical testing. |
| Surface Roughness | 10Å rms | Consistent with pitch polishing. | Not measured |
| Scratch & Dig | 60-40 per Mil-O-13830 | No visible scratches | Visual Inspection. No standard available. |
| Figure: | <16.65 nm rms | 12 nm rms | Center of curvature test after cutting. Durango software. |
| Rear Surface Figure | Plano +/- 10 fringes | <u>>10 fringes</u> | Measured with testplate before cutting |
| Rear surface Perpendicularity | 21.6 seconds | 13.4 +/- 4.5 seconds | Surface runout measured on air bearing. Edge thickness measured after cutting. |

Comments on inspection data for ARIES Camera Mirror 3 (Dwg 10445):

Dimensions:

The out of specification condition may be attributed to my concern of what happened with the parabola. If it makes a big difference, I can grind one side a little to remove the 0.001" of material. One additional anomaly: when cutting the long dimension, I was making passes about 2 mm deep. After the first pass I measured the 160 mm dimension and found it was too short. So, for the remainder of the passes, I moved the saw blade out to the proper dimension. This had the effect of leaving a small step on one side at the rear of the mirror.

Wedge and Rear surface perpendicularity:

The parts were made with the flat reference surface finished first. (A copy of the process plan is attached). Throughout the remainder of processing, the wedge was minimized to the extent possible with our machinery.



As a check after cutting and shaping, the setup shown at left was used. An electronic indicator that was accurate to the micron range was placed on the table. A small steel block was glued to the table top and the part was placed with the flat side on the table and one edge against the block. The probe from the indicator is zeroed on the first side and the part was rotated with the opposite edge against the

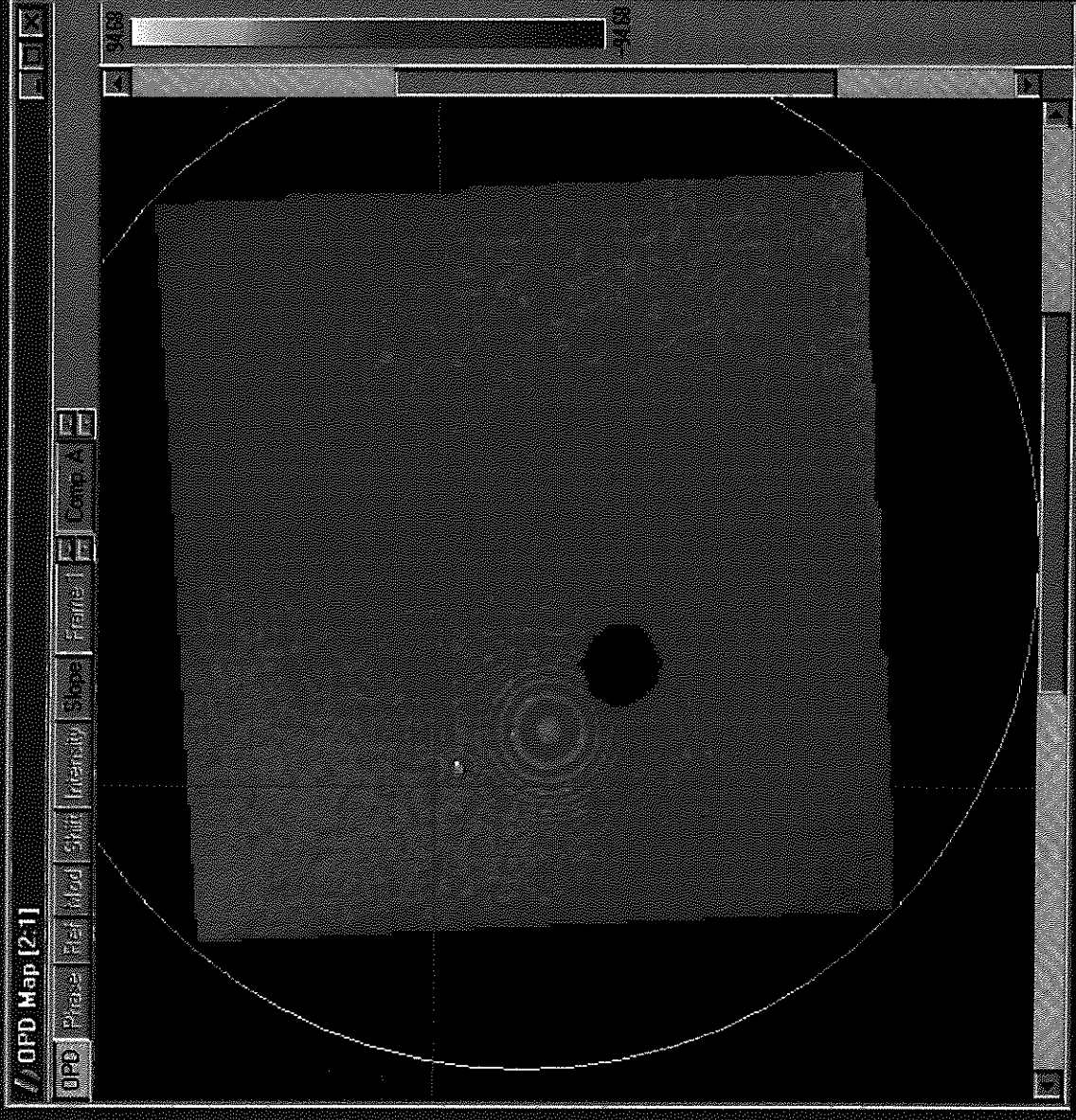
block. This made sure that the probe extended into the surface exactly the same amount on each side.



The part was then rotated 90 degrees and the process repeated against the long side. The difference in edge thickness across the part is a direct measurement of the wedge and (also the rear surface perpendicularity). Knowing the thickness difference and the dimensions of the part, an angle may be calculated.

Remove Tilt Power Asig Data Spk. Cyl Sym Asym Res Invert Morph Ref

OPD Phase Ref Mod Shift Intensity Slope Frame Comp A



PV 189.4 nm RMS 12.20 nm

| Coef# | Representation |
|---------------------------------------|---------------------------------------|
| <input type="checkbox"/> 1 | 45.2984 1 |
| <input checked="" type="checkbox"/> 2 | 611.9305 R cos(A) |
| <input checked="" type="checkbox"/> 3 | 496.4149 R sin(A) |
| <input type="checkbox"/> 4 | 23.8856 R ² cos(2A) |
| <input checked="" type="checkbox"/> 5 | -11.7322 2R ² - 1 |
| <input type="checkbox"/> 6 | -33.9956 R ² sin(2A) |
| <input type="checkbox"/> 7 | -9.3060 R ³ cos(3A) |
| <input type="checkbox"/> 8 | -6.9191 (3R ³ - 2R) cos(A) |

| Date/Time | Wed Jan 10, 2001 11:52:31 |
|------------|--|
| ADC S/N | 535-875152751 |
| Job | ARIES |
| Title | Camera Sphere |
| Part No | 10445 |
| Serial No | 1 |
| Surface | |
| Operator | |
| Instrument | |
| Notes | Center of curvature. Masked to OCA. Interferometer hot spot masked out. Average of 5. After etching edges. Final data. |

010110Amskdfullavg.opd

File Information

File: N:\Small Optics\Aries\Sphere\010110Amskdfullavg.opd

Acquired: Wed Jan 10, 2001 11:52:31

Title: Camera Sphere

PartNo.: 10445

Job: ARIES

Serial No.: 1

Instrument:

Operator:

Surface:

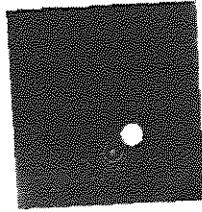
OPD map

Frame 1

PV: 189.4 nm RMS: 12.20 nm

REMOVED:

- Ref.
- Tilt
- Power
- Astig.
- Coma
- Sph.
- Cyl.



Zernike Fit

Parameters

| | Coef. | Representation |
|----|----------|--------------------------|
| 1 | 45.2994 | 1 |
| 2 | 611.9305 | $R \cos(A)$ |
| 3 | 496.4149 | $R \sin(A)$ |
| 4 | 23.8856 | $R^2 \cos(2A)$ |
| 5 | -11.7322 | $2R^2 - 1$ |
| 6 | -33.9956 | $R^2 \sin(2A)$ |
| 7 | -9.3060 | $R^3 \cos(3A)$ |
| 8 | -6.9191 | $(3R^3 - 2R) \cos(A)$ |
| 9 | 3.2651 | $(3R^3 - 2R) \sin(A)$ |
| 10 | 0.3909 | $R^3 \sin(3A)$ |
| 11 | 11.2759 | $R^4 \cos(4A)$ |
| 12 | 22.0722 | $(4R^4 - 3R^2) \cos(2A)$ |
| 13 | -3.7499 | $6R^4 - 6R^2 + 1$ |
| 14 | -5.6168 | $(4R^4 - 3R^2) \sin(2A)$ |
| 15 | -6.2633 | $R^4 \sin(4A)$ |

OPD Algorithm 5A x 90°
 Fit Algorithm Gauss-Jordan Elimination
 Smoothing Off
 Wave Length 0.63282 um
 Waves/Fringe 0.50
 Min Modulation 0.00
 Erode off
 Min Intensity off
 Max Slope off

FID.3 1mg by lens L1

| | | | | INSPECTION DATA | | |
|----------------------|----------------------|-------------------|---------------|-------------------|-------------------------|-----------------|
| Customer PO# P251841 | | | | WO# 1289-09 | PN 4498 | Date |
| Full Quantity 1 | | Quantity Tested 1 | | Material BaF2 | 10449 | Lot # 1 |
| Parameter | | Specifications | | Parameter | | Specifications |
| N | | NOM | TOL | N | NOM | TOL |
| 1 | Diameter or Length | 46.072 | +1.00 -.05 | 11 | Irreg. S1, Fr. or Wv. | 16.65 nm rms |
| 2 | Width | | | 12 | Surface Quality / SD S1 | 60-40 |
| 3 | Clear Aperture 1, mm | 42.00 | | 13 | Radius S2, mm | 87.930 +/- .100 |
| 4 | Clear Aperture 2, mm | 42.00 | | 14 | Power S2, Fr. or Wv. | - |
| 5 | SAG 1, mm | | | 15 | Irreg. S2, Fr. or Wv. | 16.65 nm rms |
| 6 | SAG 2, mm | | | 16 | Surface Quality / SD S2 | 60-40 |
| 7 | Center Thickness, mm | 7.011 | +/- .05 | 17 | TIR, mm | 50 microns |
| 8 | Full Thickness, mm | | | 18 | Wedge, mm | |
| 9 | Radius S1, mm | 95.499 | +/- .200 | 19 | | |
| 10 | Power S1, Fr. or Wv. | - | | 20 | | |
| | | | | ACTUAL (MEASURED) | | |
| | | | | Part Number | | |
| N | 1 | 2 | 3 | 4 | 5 | 6 |
| 1 | 46.033 | | | | | |
| 2 | | | | | | |
| 3 | | | | | | |
| 4 | | | | | | |
| 5 | | | | | | |
| 6 | | | | | | |
| 7 | 6.840 | | | | | |
| 8 | | | | | | |
| 9 | 95.53 | | | | | |
| 10 | | | | | | |
| 11 | | | | | | |
| 12 | < 60-40 | | | | | |
| 13 | 87.99 | | | | | |
| 14 | | | | | | |
| 15 | | | | | | |
| 16 | < 60-40 | | | | | |
| 17 | 12 microns | | | | | |
| 18 | | | | | | |
| 19 | | | | | | |
| 20 | | | | | | |

QC Inspector

GPI Application

8m Aperture Z490 Surface/Wavefront Map

MEASURE
Analyze
Mask Data
Save Data
Load Data
Calibrate
Reset

Measure Cntr
Analyze Cntr

S/W Profile

Slope Mag
Slope X
Slope Y

PSE
MTF
MTF Profile
Zernikes

ISO 10110-5

SynthFringes

Analyze Attr
Process
Report
Units
Video Monitor

Oblique Plot

Removed: PSE TLT PWR
Aperture ID (%):
Aperture ID (%):
Trimmed: I
Filter: Off

Surface/Wavefront Profile

PV 0.325 wave
rms 0.053 wave
Power 0.126 wave
Size X 43.0 mm
Size Y 42.5 mm

PV 0.150 wave rms 0.029 wave

Measurement Attributes

Thu Dec 09 18:33:41 1999
P/N: 10449 B
PO#: P251841
E/10.3 Imager, Lens 1, 87.99 ROC

Date Sign: Normal
Scale Factor: 0.5
Camera Res: 233.5 um

Z490 Intensity Map

Aband

This is the worst case measurement - I forgot to turn on the aperture.



Optical Solutions Incorporated

Customer Name: University of Arizona
Purchase Order: P685221
Customer PN: F/10.3 Imaging Lens L1
Quantity: 1
Quantity Tested: 1

OSI WO#: 1581-01
PN: 4727
Material: BaF2
Date: 6/18/03
Lot#: 1

| Parameter | Specification | Actual Meas. #1 |
|-------------------------|----------------------|-----------------|
| Diameter | 27.042 +.00 -.10 | 27.033 |
| Width | - | - |
| Center Thickness | 4.407 +/- .025 | 4.397 |
| Radius S1 | 39.224 +/- .033 (cx) | 39.224 (cx) |
| Sag S1 | 2.404 | 2.403 |
| Power S1 (wv) | - | - |
| Irregularity S1 (wv) | 2.000 | 1.423 |
| Surface Quality / SD S1 | 60/40 | <60/40 |
| Clear Aperture S1 | 24.00 | 24.00 |
| Radius S2 | 77.164 +/- .130 (cc) | 77.164 (cc) |
| Sag S2 | 1.194 | 1.193 |
| Power S2 (wv) | - | - |
| Irregularity S2 (wv) | 2.000 | .783 |
| Surface Quality / SD S2 | 60/40 | <60/40 |
| Clear Aperture S2 | 24.00 | 24.00 |
| TIR | .025 | .001 |
| Wedge | - | - |
| Flat dimension | - | - |
| ID dimension | - | - |
| Coating | None | None |

NOTES:

Sm Aperture Zygo

Oblique Plot

Removed: EST TLT PWR

Trimmed: 0

Aperture OD (\$): 89 Aperture ID (\$): 0 Filter: Off

MEASURE Analyze Mask Data Save Data Load Data Calibrate Reset

Analyze Cntr

S/W Profile

Slope Mag

Slope X

Slope Y

PBF

MTF

MTF Profile

Zernikes

ISO 10110-5

SynthFringes

Measure Attr

Analyze Attr

Process

Report

Units

Video Monitor

Measurement Controls

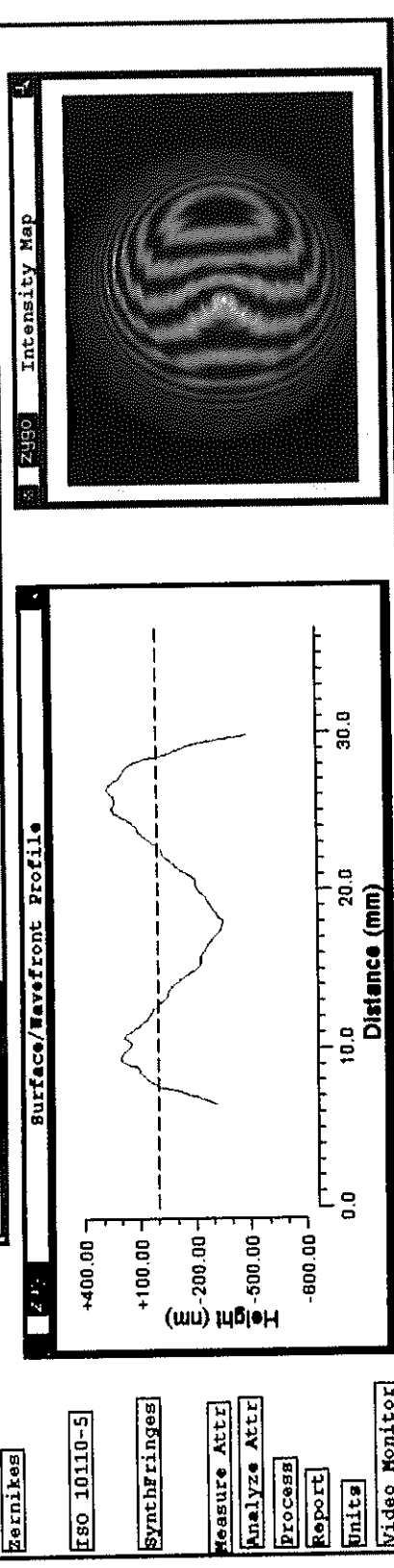
Comment: U OF A ARIES - F/10.3 IMAGING LENSES - VER.14 39.224 ROC CX

Drawing Number: L1 Phase Res: High

Purchase Order Number: P685221 AGC: On

Instrument: Mark GBF Id 0 SN 4624 SB 0 Phase Avgs: 0

Data Sign: Normal Intens Avgs: 0



MEASURE Analyze Mask Data Save Data Load Data Calibrate Reset

Analyze Cntr.

S/W Profile

Slope Mag

Slope X

Slope Y

DSP

MTF

MTF Profile

Zernikes

ISO 10110-5

Syntheticfringes

Measure Attr

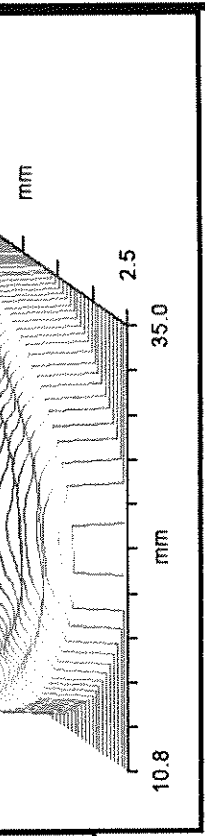
Analyze Attr

Process

Report

Units

Video Monitor



| | | |
|-------|-------|------|
| PV | 0.783 | wave |
| rms | 0.121 | wave |
| Power | 0.058 | wave |



Removed: PST TLT FWR

Aperture OD (%): 0

Aperture ID (%): 0

Trimmed: 0

Filter: Off

Measurement Controls

Comment: U OF A ARIES - F/10.3 IMAGING LENSES - VER.14 77.164 ROC CC

Drawing Number: L1

Purchase Order Number: P685221

Instrument: Mark GPI Id 0 SN 4624 SB 0

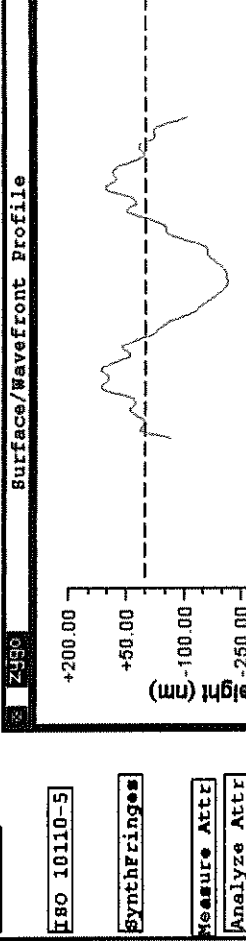
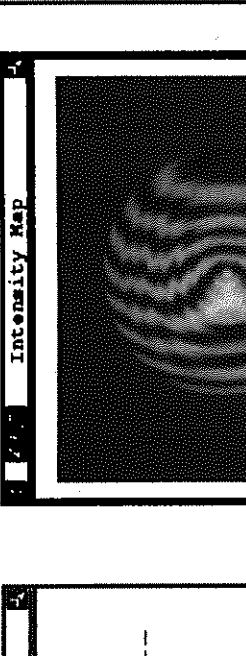
Data Sign: Normal

Phase Res: High

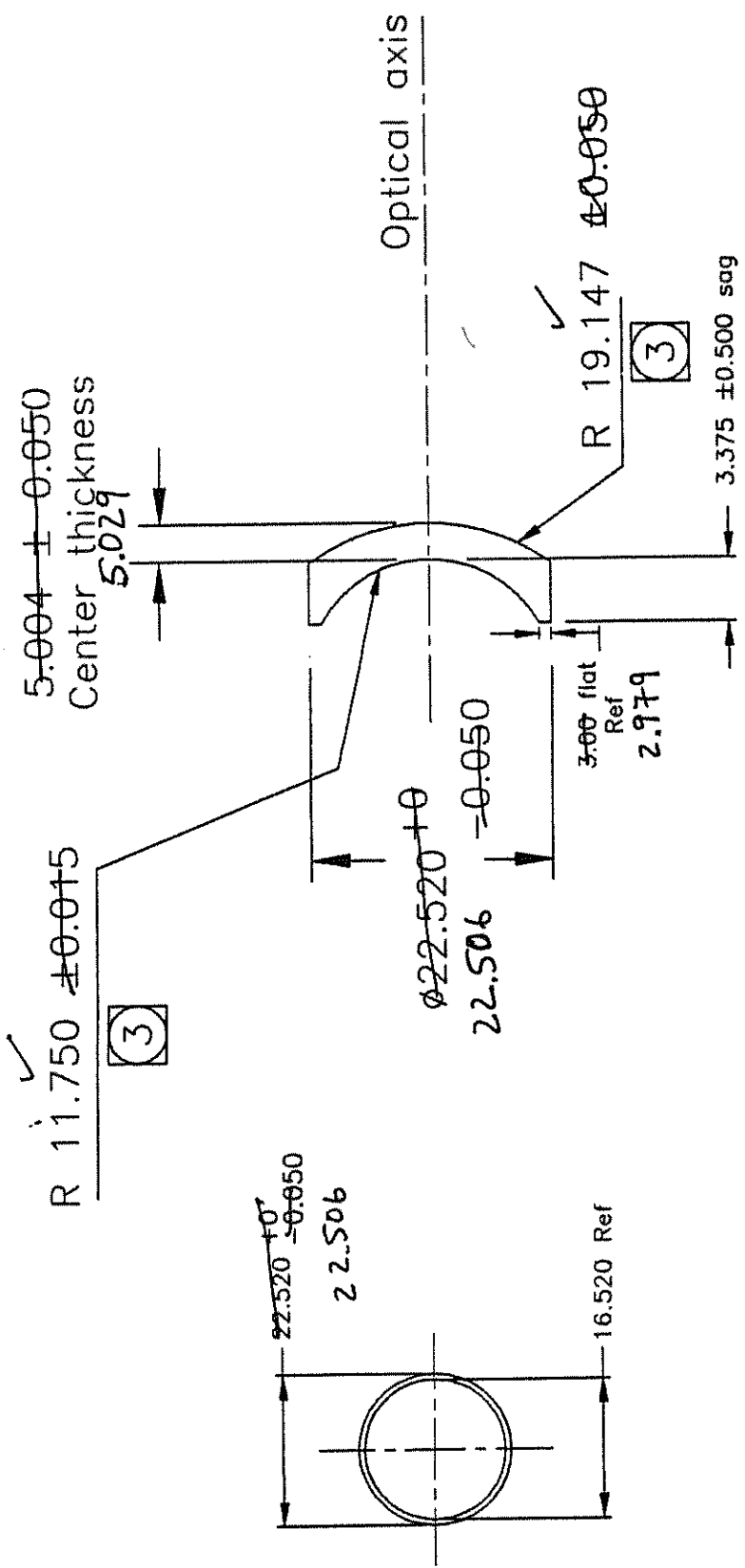
AGC: On

Phase Avgs: 0

Intens Avgs: 0



| REVISIONS | | |
|-----------|---|-----------|
| LTR | DESCRIPTION | DATE |
| B | Put flat on edge of optic, fit to test plates | 6/28/99 |
| | | R. Sarlot |
| | | APPROVED |



| | | | | |
|-----------------------------|-------------------|---------------------------------|----------|-----------------|
| UNLESS OTHERWISE SPECIFIED: | | DESIGNED BY: | DATE: | PROJECT: |
| TOLERANCES ON: | FRAC TIONS ANGLES | R. SARLOT | 05/08/99 | ARIES |
| DECIMALS | XX | CHECKED BY: | 03/19/99 | TITLE: |
| XXX | XX | R. SARLOT | | F/10.3 Imaging |
| AS NOTED | | D. McCarthy | 7/27/99 | LENS #2 |
| DIMENSIONS ARE IN: | | APPROVED: | | DRAWING NUMBER: |
| ENGLISH METRIC | | | | 10450 |
| MATERIAL: | | APPROVED: | | SCALE: |
| | | | | None |
| FINISH | | JOB NO.: | | |
| | | | | |
| | | CURRENT TMR/INTZ/FILE LOCATION: | | |
| | | FILE ARCHIVE LOCATION: | | |

CONTACT: ROLAND SARLOT 520-626-7252
 Steward Observatory, University of Arizona
 933 N. Cherry Avenue, Tucson, AZ 85721 (520)821-7658

Material: CVD ZnSe n(587.5618nm)=2.62411 ±0.0001
 No grain boundary
 No visible inclusions
 Optical Surfaces:
 Scratch dig 60/40 per MIL-0-13830A
 Micro roughness/finish <10A rms
 Figure <16.65nm rms
 Wedge < 0.102 degrees (TIR 40um) 0.043 (IR 17um)
 Pitch polish to edge
 Chamfer all edges with 0.5mm face width max by 45 degrees
 Clear aperture - in. surface 13.5mm diam, Out. surface 16.5mm diam
 High transmission coating for 1.0um to 5.0um -Not yet specified
 Must withstand 77K operating temperature
 All surface dimensions are at standard Temp & Pressure
 Radii fit to vendor's test plates
 Request inspection report based on all measured data.

f/10.3 imaging lens L2

| | | | | INSPECTION DATA | | |
|----------------------|----------------------|-------------------|----------------|-------------------|-------------------------|-----------------|
| Customer PO# P251841 | | | | WO# 1289-10 | PN 4499 | Date |
| Full Quantity 1 | | Quantity Tested 1 | | Material ZnSe | 10450 | Lot# 1 |
| Parameter | | Specifications | | Parameter | | Specifications |
| N | | NOM | TOL | N | NOM | TOL |
| 1 | Diameter or Length | 22.520 | +0.00 -0.05 | 11 | Irreg. S1, Fr. or Wv. | 16.65 nm rms |
| 2 | Width | | | 12 | Surface Quality / SD S1 | 60-40 |
| 3 | Clear Aperture 1, mm | | | 13 | Radius S2, mm | 19.147 +/-0.05 |
| 4 | Clear Aperture 2, mm | | | 14 | Power S2, Fr. or Wv. | — |
| 5 | SAG 1, mm | | | 15 | Irreg. S2, Fr. or Wv. | 16.65 nm rms |
| 6 | SAG 2, mm | | | 16 | Surface Quality / SD S2 | 60-40 |
| 7 | Center Thickness, mm | 5.004 | +/-0.05 | 17 | TIR, mm | 40 micron |
| 8 | Full Thickness, mm | | | 18 | Wedge, mm | — |
| 9 | Radius S1, mm | 11.750 | +/-0.015 | 19 | Flat | 3.00 ref. |
| 10 | Power S1, Fr. or Wv. | — | — | 20 | ID | 16.520 ref. |
| | | | | 21 | ID (C) | — concentricity |
| | | | | ACTUAL (MEASURED) | | |
| | | | | Part Number | | |
| N | 1 | 2 | 3 | 4 | 5 | 6 |
| 1 | 22.506 | | | | | |
| 2 | | | | | | |
| 3 | | | | | | |
| 4 | | | | | | |
| 5 | | | | | | |
| 6 | | | | | | |
| 7 | 5.029 | | | | | |
| 8 | | | | | | |
| 9 | 11.750 | | | | | |
| 10 | | | | | | |
| 11 | | | | | | |
| 12 | < 60-40 | | | | | |
| 13 | 19.147 | | | | | |
| 14 | | | | | | |
| 15 | | | | | | |
| 16 | < 60-40 | | | | | |
| 17 | 17 microns | | | | | |
| 18 | | | | | | |
| 19 | 2.979 | | | | | |
| 20 | 16.550 | | | | | |
| 21 | 10 microns | | | | | |
| | | | | QC Inspector | | |



Optical Solutions Incorporated

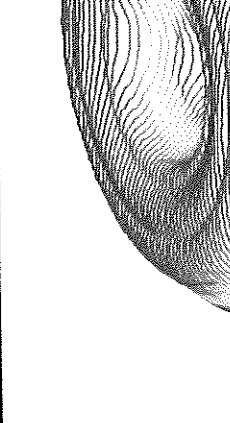
Customer Name: University of Arizona
Purchase Order: P685221
Customer PN: F/10.3 Imaging Lens L2
Quantity: 2
Quantity Tested: 2

OSI WO#: 1581-02
PN: 4728
Material: ZnS Cleartran
Date: 6/18/03
Lot#: 1

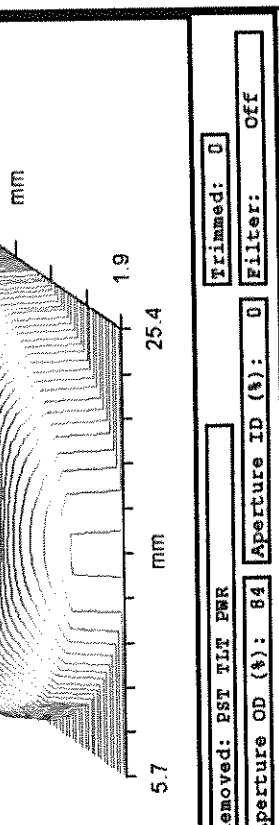
| Parameter | Specification | Actual Meas. #1 | Actual Meas. #2 |
|----------------------------|------------------------|-----------------|-----------------|
| Diameter | 19.016 +.00 -.10 | 19.010 | 19.009 |
| Width | - | - | - |
| Center Thickness | 3.002 +/- .010 | 2.982 | 3.007 |
| Radius S1 | 37.617 +/- .063 (cx) | 37.617 (cx) | 37.617 (cx) |
| Sag S1 | 1.221 | 1.221 | 1.221 |
| Power S1 (wv) | - | - | - |
| Irregularity S1 (wv) | 2.000 | .712 | .399 |
| Surface Quality / SD S1 | 60/40 | <60/40 | <60/40 |
| Clear Aperture S1 | 16.00 | 16.00 | 16.00 |
| Radius S2 | 12.3725 +/- .0055 (cc) | 12.3725 (cc) | 12.3725 (cc) |
| Sag S2 | 3.390 | 3.395 | 3.411 |
| Power S2 (wv) | - | - | - |
| Irregularity S2 (wv) | 2.000 | 1.505 | 1.252 |
| Surface Quality / SD S2 | 60/40 | <60/40 | <60/40 |
| Clear Aperture S2 | 16.00 | 16.00 | 16.00 |
| TIR | .015 | .001 | .001 |
| Wedge | - | - | - |
| Flat dimension - reference | 1.000 | .992 | .974 |
| ID dimension | 17.016 | 17.027 | 17.061 |
| Coating | None | None | None |

NOTES: Don - #1 is 10 microns undersized on thickness.

MEASURE
 Analyze
 Mask Data
 Save Data
 Load Data
 Calibrate
 Reset

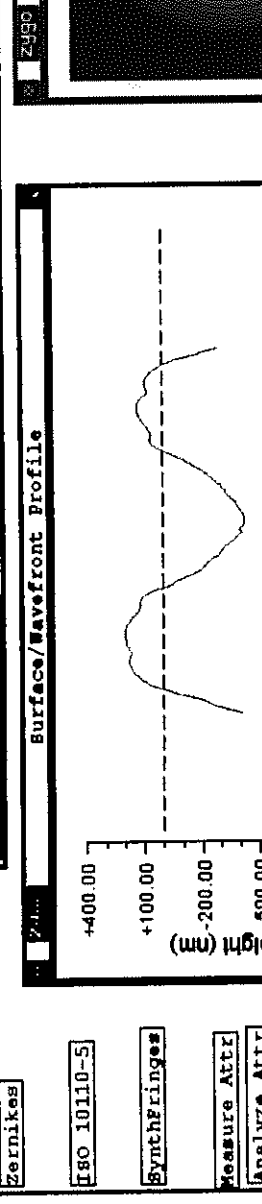
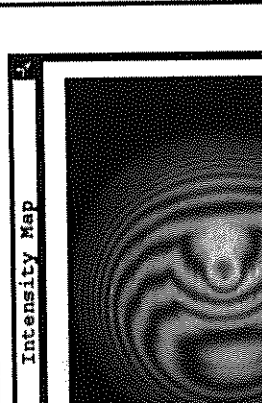


| | |
|-------|-------------|
| FV | 1.505 wave |
| rms | 0.296 wave |
| Power | -1.223 wave |



Removed: PST TLT PWR Trimmed: 0
 Aperture OD (%): 84 Aperture ID (%): 0 Filter: Off

Measurement Controls
 Comment: U OF A ARTES - F/10.3 IMAGING LENSES - VER. 14 12.373 ROC.CC #1
 Drawing Number: I2 Phase Res: High
 Purchase Order Number: E685221 AGC: On
 Instrument: Mark GPI Id 0 SN 4624 BB 0 Phase Avgs: 0
 Data Sign: Normal Intens Avgs: 0



- Analyze Cntr
- S/W Profile
- Slope Mag
- Slope X
- Slope Y
- PBP
- MTF
- MTF Profile
- Zernikes
- ISO 10110-5
- SynthFringes
- Measure Attr
- Analyze Attr
- Process
- Report
- Units
- Video Monitor

MEASURE Analyze Mask Data Save Data Load Data Calibrate Reset

8m Aperture Z490 Z490 Oblique Plot

+0.05465 um
-0.19785 19.2

8.3 mm 24.3 mm 3.2 mm

Removed: PST TLT PBR

Aperture OD (mm): 84 Aperture ID (mm): 0

Trimmed: 0 Filter: Off

EV 0.399 wave
RMS 0.049 wave
Power 0.114 wave

Measurement Controls

Comment: U OF A ARIES - F/10.3 IMAGING LENSES - VBR.14 37.617 ROC CX #2

Drawing Number: L2 Phase Res: High

Purchase Order Number: 9685221 AGC: On

Instrument: Mark GPI Id 0 SN 4624 SB 0 Phase Avgs: 0

Data Sign: Normal Intens Avgs: 0

Surface/Wavefront Profile

Height (um) vs Distance (mm)

Surface/Wavefront Profile

Z490 Intensity Map

Z490 Intensity Map

- Analyze Contr.
- S/W Profile
- Slope Mag
- Slope X
- Slope Y
- P8P
- MTP
- MTF Profile
- Zernikes
- ISO 10110-5
- SynthFringes
- Measure Attr
- Analyze Attr
- Process
- Report
- Units
- Video Monitor

MEASURE Analyze Mask Data Save Data Load Data Calibrate Reset

Analyze Cntr

S/W Profile

Slope Mag

Slope X

Slope Y

ISO

MTF

MTF Profile

Zernikes

ISO 10110-5

SynthFringes

Measure Attr

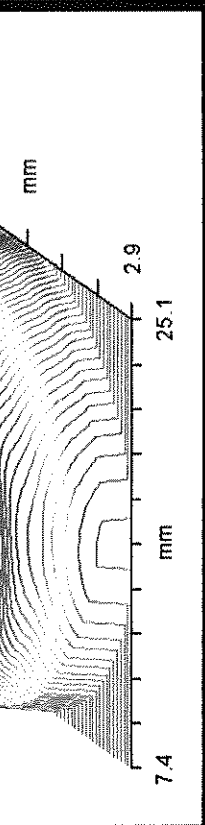
Analyze Attr

Process

Report

Units

Video Monitor



| | | |
|-------|--------|------|
| PV | 1.252 | wave |
| RMS | 0.285 | wave |
| Power | -1.302 | wave |

Removed: PST TLT PWR

Aperture ID (%): 0

Aperture ID (%): 84

Aperture ID (%): 0

Trimmed: 0

Filter: Off

Measurement Controls

Comment: U OF A ARIES - F/10.3 IMAGING LENSSES - VER.14 12.379 ROC GC #2

Drawing Number: L2

Purchase Order Number: P685221

Instrument: Mark GPI Id 0 SN 4624 SB 0

Data Sign: Normal

Phase Res: High

ACC: On

Phase Avgs: 0

Intens Avgs: 0

