

4ITM07-C

LIGO-T990157-00-D

BLANK MATERIAL

A. DCN: LIGO-T970042-00-D LIGO DETECTOR OPTICS
B. LIGO S/N: IM 12 Incoming Inspection Check-off Sheet
Core Optics Blank Material

The purpose of this sheet is to verify material physical dimensions, perform visual inspection, and to facilitate material traceability of LIGO Detector optics. This sheet is to be included in the LIGO Quality Assurance traceability file. Complete a check-off sheet for each optic blank received and inspected.

C. LIGO Contract No.: PC 208421 D. Glass Mfg./Order No: Heraeus/5001652
E. Core optic Material: (BS / FM / ITM / ETM / RM) F. Glass Mfg. Part No.: 50784
G. LIGO Drawing No.: D960794-A-D H. Manufacturer's Boule No.: _____
I. Date Received at Caltech: ~~11-05-97~~ 11-05-97

J Verify glass manufacturer's ^{inspection report} ~~Certification~~ against LIGO Component Specification No. E 960095-A-D
Attach the applicable Component Specification Verification sheet.

K Attach a copy of the glass manufacturer's ^{inspection report} ~~Certification~~ to check-off sheet.

L Attach the glass manufacturer's birefringence map, inclusion map, and data sheet per the above Component Specification. birefringence map, inclusion map not present

M Visually inspect for shipping container for damage. If applicable, describe the damage on attached.

N Visually inspect the blanks for damage, for chips on surfaces and edges, or for other defects. If applicable, describe damage/defects on attached sheet.

O Verify core optic blank physical dimensions per applicable LIGO drawing.

Inspection of material diameter. Diameter 10.10 in 256.6 mm

Inspection of material thickness. Thickness 4.29 in 108.9 mm

P Verify that the Registration Mark is present (with arrow pointing to the first surface) as required by LIGO Component Specification. No registration mark present

Q Verify receipt of 25mm X 25mm cylinder Witness Sample(s) required by the LIGO Component Specification and visually inspect for damage. Describe damage on the attached sheet. shipped separately

R Sign and date original packing slip (shipper) and distribute per paragraph 3.R. 11-05-97

Inspect By: [Signature] Date Inspected: ~~11-05-97~~ 12-22-97 [€]

Reviewed and/or accepted by:

Cognizant Engineer: _____ Date: _____

LIGO QA Officer or Designee: _____ Date: _____

LIGO DETECTOR OPTICS
Incoming Inspection Check-off Sheet

Core Optics Blank Material

COMMENTS/DISCREPANCIES: (Disposition damage/discrepancies per LIGO Quality Assurance Plan (LIGO M960076-00-P) paragraphs 5.12 and 5.12.1.) No data disk (FTP not referenced)

Minimal chamfer. No defect map. No registration marks.
No interferograms or homogeneity maps. No birefringence
map. No inclusion sketch. No absorption certification.
Striae not reported. No OH-content reported.

Witness sample shipped separately.

SKETCHES:

DISPOSITIONS: Received new inspection report 12-30-97
Received defect, inclusion, and striae sketch.
Received residual strain report.
Received OH-content report and graph.
Received interferograms and homogeneity maps.

POL-QW

Project LIGO

Customer : HERAEUS Amersil Inc. Duluth, Ga 30136-5821
Order No. : 45000023300dtd 30.09.96 as
HAI-Order No. : none
HQS-Order No. : 94908401
Item No. : 1
Quality : Fused silica Suprasil 312 S
HQS melt No. : MF.F 8967
Marking : 960095-IM12 *13N 6653*

Diameter : 256,5 mm
CA Diameter : $\emptyset 200 \text{ mm} = 1,9 \times E^{-6}$
Thickness : 108.9 mm
Edge : 0,3 - 0,5 mm
Parallelism : 0,08 mm
Roughness : ground
 R_a : 1,08 μm
 R_z : 8,86 μm
Bubble class : 0 ; none bubbles
Birefringence : CA $\emptyset 200 \text{ mm} \leq 5 \text{ nm/cm}$; CA $\emptyset 80 \text{ mm} \leq 1 \text{ nm/cm}$
Homogeneity : see Interferogram
Striae Grade : A
Granularity : none
Remark : Test Sample ($\emptyset 25 \times 25 \text{ mm}$) with the same marking

POL - Qualitätsprüfung Optik

Date : 22.09.1997

Inspector : 

Heraeus
QUARZGLAS

POL-QW

Order Nr.: 94908401 Pos.: 1

Ø 256,5 mm x 108,9 mm

Quality: Suprasil 312

Plate No.: 96 0095/1M 12/6653

Date: 22.9.97

Inspector:



Diameter	0,03mm	0,05mm	0,08mm	0,12mm	0,2mm	0,31mm	Sum
piece							
mm ²							

TBCS=

mm²
/100cm³

Heraeus
QUARZGLAS

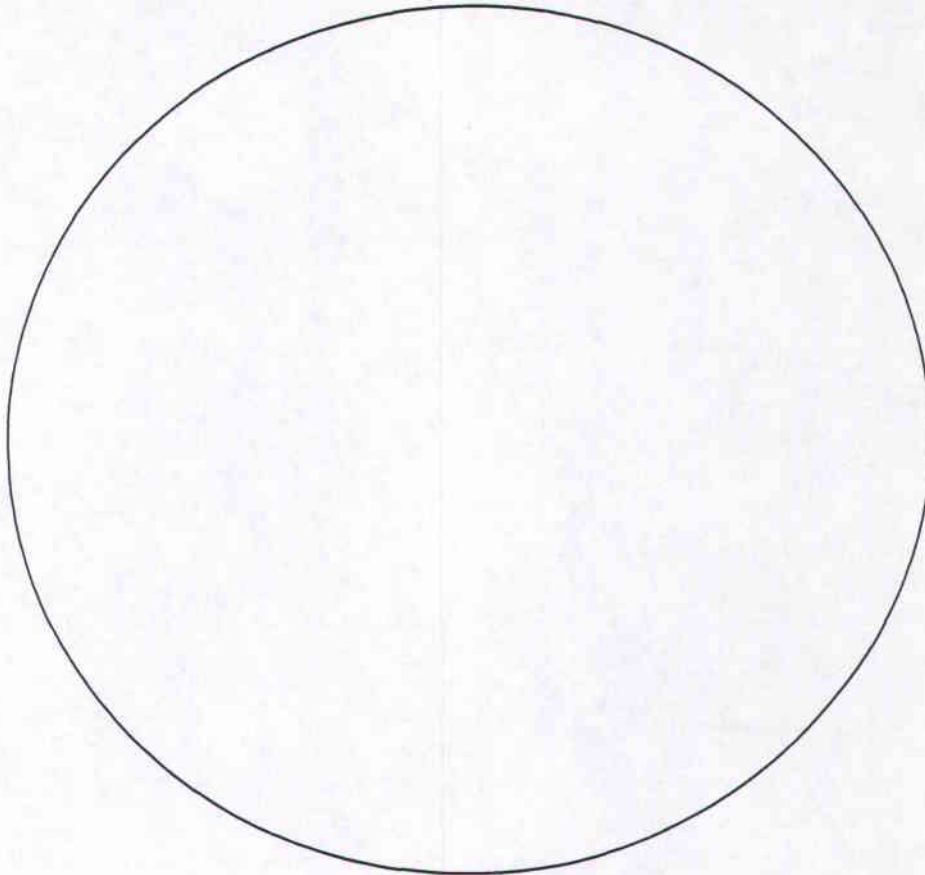
POL - QW

Order No.: 94908401 Pos.: 2
Ø 256,5 mm x 108,9 mm

Plate No.: 960095-1M12/6653
Residual strain- Report

Date: 22.9.97

Inspector: *[Signature]*



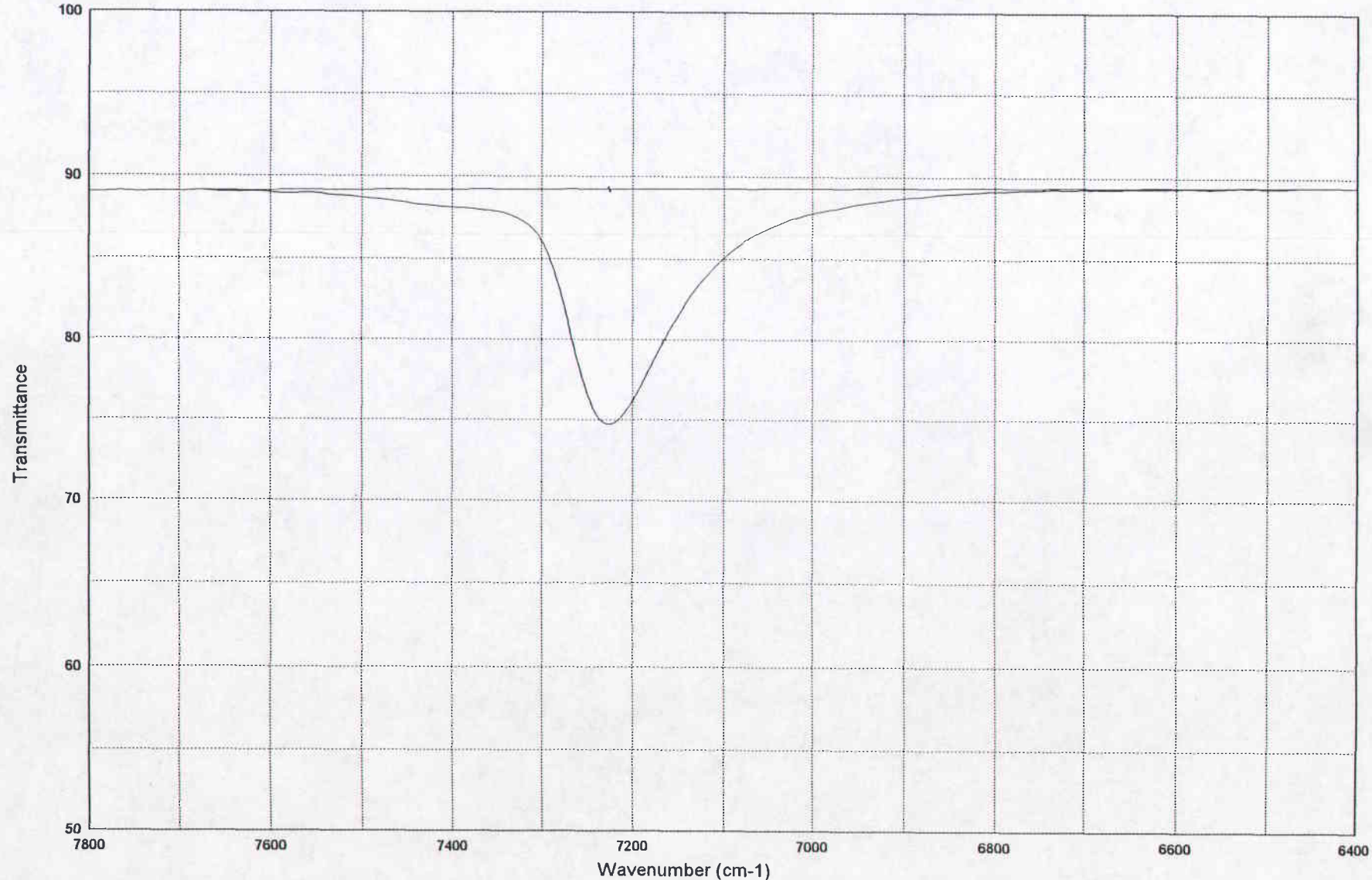
Edge	Center						Pos.
20							nm
2	<1						nm/cm

I0=89.2497 , I1=74.7178 at x=7226

OH-content: 309.5 ppm

Heraeus
QUARZGLAS

MEASURE NO. : 6653_RA
DATE : 06.11.1997 TIME : 12:18
MEASURE START : 10000 1/cm
MEASURE END : 2000 1/cm
OP-DISK-PATH LENGTH : Fuchs-242-PL: 3.99 cm / Order No.: 99303625 Material: 6653 Rand A—OH-content: 309.5 ppm at x=7226



Heraeus
QUARZGLAS

POL-QW

Data taken at 632.8 nm

Date: 22.09.97 Operator: Da
ID: 665300 No.:

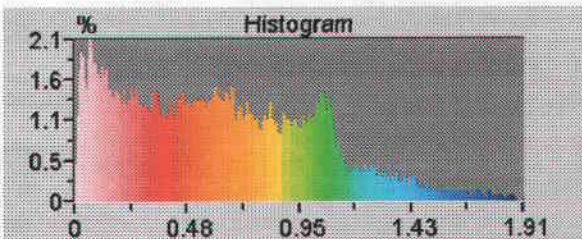
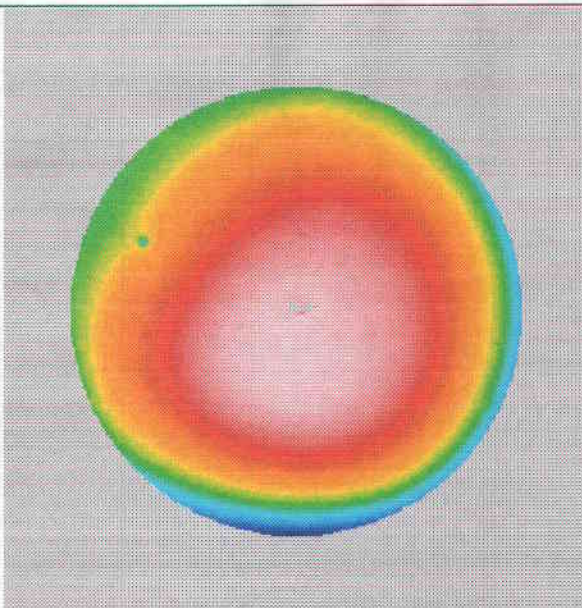
HQS-Order-No.: 98492867

Customer: HAI
Product: LIGO
Pos.-No.: 1

Order-No.:
Comment: 960095-im-12

Thickness: 109.0 mm
sample diameter: 280.0 mm
CA diameter: 200.0 mm
examined diameter: 200.3 mm

Center: (0.0mm,0.0mm)
Radius: 100.1mm
Points: 69729

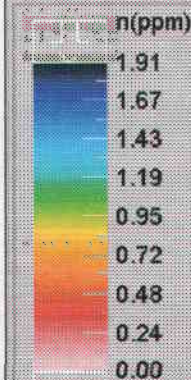


Sub. Terms	Magn.	Angle
X Tilt	0.3575	-47.1667
Focus	0.6355	
Astigm.	0.0837	19.1145
Coma	0.2356	116.7993
SA3	0.0984	

Phase Data

Unit n(ppm)
PV: 1.91
RMS: 0.385
Scale: 0.5

Contrast



Reset

UpperL: 1.907
LowerL: 0.000

File: 665300.dat, 22.09.97, 16:30

XPS-12"



Heraeus Amersil Inc
 3473 Satellite Blvd.
 Duluth, GA 30096

Heraeus AMERSIL

Sales Order #: 5001652
 Delivery #: 30037568

Delivery Note/ Packing List

Terms: FOB Duluth
 Customer PO #: pc208421

SOLD TO: Customer # 1658
 CALIFORNIA INST OF TECH
 ACCOUNTS PAYABLE 201-6
 PASADENA, CA 91125
 USA

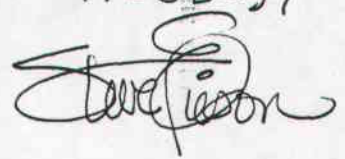
SHIP TO: CUSTOMER # 5594
 CALIFORNIA INST OF TECH
 Attn: Gari Billingsley
 391 SOUTH HOLLISTON
 PASADENA, CA 91125
 USA

51-33

Order Date: 09/24/1996
 Account #:
 Tracking #: 1Z3944240200054358

Salesman: 00000020 MARC SCHNEIDER
 Route: UPS002 UPS Blue 2 Day PPA
 Total Weight: 42.000 LB
 Shipping Cartons: 00001

LINE ITEM	MATERIAL NUMBER	DESCRIPTION	UOM	SHIP DATE	NOTICE	CURRENT SHIPMENT
000002	50784	DISC, SUP 312, G, 256 X 108 SUPRASIL 312 DISC, GROUND, 256MM DIA X 108MM THK LIGO PROJECT DWG D960794-A-D REV A AND SPECIFICATION LIGO-E960095 REV A	EA	11/09/1998	<p>Open cartons and compare to bill of lading and packing list promptly. Claims for shortages or breakage must be made within 15 days after receipt of goods.</p> <p>Unpack with great care. Please do not discard the packing case nor any of the packing material until contents of case have been carefully checked and found correct and in good order.</p> <p>In case of damaged materials regardless of the external condition of the cartons, the consignee must institute the following procedure. Where shipments are made FOB Point of Shipment, it is the consignee's responsibility to file claim with the carrier and obtain an inspection report from the carrier for truck, air freight or parcel post shipments. For UPS shipments or FOB Destination shipments, all requests for inspection of damaged material should be made by the shipper and the consignee must notify Heraeus-Amersil Inc. promptly of such breakage to institute a claim. Damaged material, packing material, and packing case must be retained for carrier's inspection.</p> <p>Return no goods unless authorized. If material is not satisfactory, notify us and hold material subject to our order.</p>	1.000

Rec'd complete
 11-05-97


ES

POLISHED SUBSTRATE

A. DCN: LIGO-

B. LIGO S/N: 4ITM07-C

LIGO DETECTOR OPTICS

Incoming Inspection Check-off Sheet
Core Optics Polished SubstratePage 1 of 3

The purpose of this sheet is to verify material physical dimensions, perform visual and microscopic inspection, and to facilitate material traceability of LIGO Detector optics. This sheet is to be included in the LIGO Quality Assurance traceability file. Complete a check-off sheet for each optic blank received and inspected.

C. LIGO Contract/Purchase No.: PC167159 D. Substrate Polisher: CSIRO
E. Core optic Material: BS / FM / 2ITM / (4ITM) ETM / RM F. Date Received: 6-08-99

G Verify glass polisher's Certification with LIGO Component Specification No. E960093-C-D.
Attach the completed LIGO Component Specification Verification Sheet.

H Attach a copy of the glass polisher's Certification Document and data sheet to check-off sheet.

I Verify receipt of an IBM PC compatible disc in ASCII format of all Surface Data per the applicable LIGO Component Specification sheet

J Attach the surface maps supplied by vendor per above Component Specifications to the check off sheet.

K Visually inspect for shipping container damage. If applicable, describe damage on attached sheet and notify the Cognizant Engineer

L Visually inspect the polished substrate for shipping damage, for chips on surfaces and edges, or for other defects. If applicable, describe damage/defects on attached sheet and notify Cognizant Engineer.

M Verify polished substrate's physical dimensions per applicable LIGO drawing.

<input checked="" type="checkbox"/>	Inspection of material diameter.	Diameter	<u>9.88</u> in	<u>250.98</u> mm
<input checked="" type="checkbox"/>	Inspection of material thickness	Thickness	<u>3.93</u> in	<u>99.99</u> mm
<input checked="" type="checkbox"/>	Wedge Angle		<u>1° 12'</u>	

N Verify that the Serial Number is present in the proper format as required by LIGO Component Specification.

O Verify that the Registration Mark (line with arrow pointing toward surface #1) is present as required by LIGO Component Specification.

P Inspect the sides and bevels with the naked eye in normal room light and against a black background to verify that there is no gray, scuffs or scratches per the applicable LIGO Component Specification.

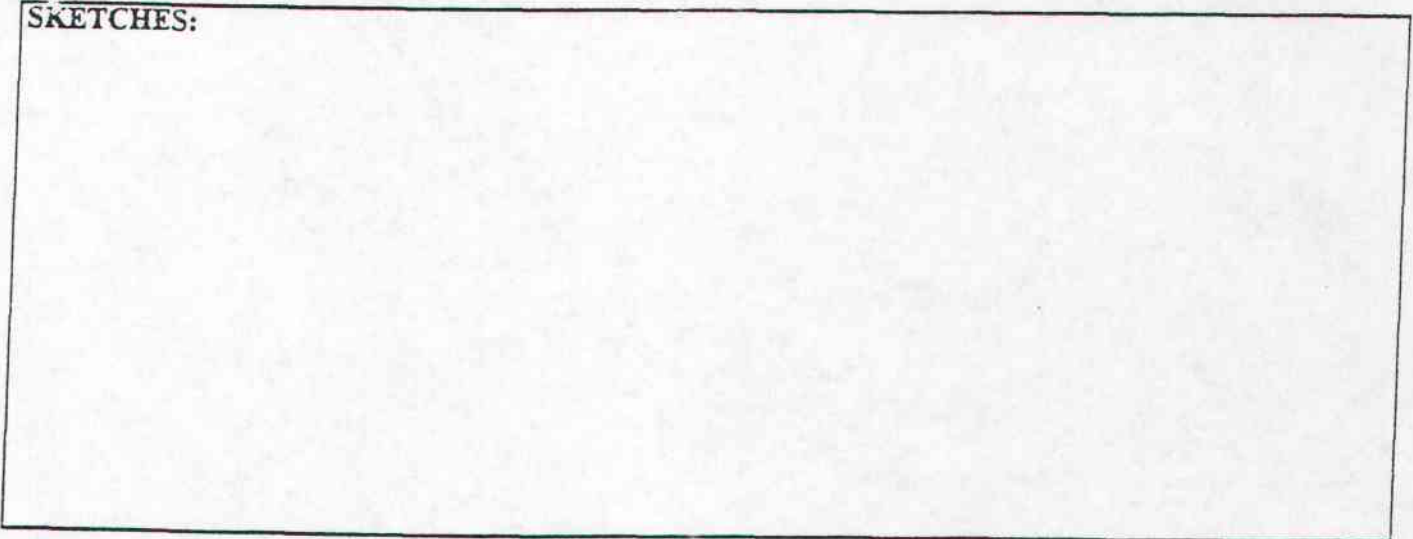
Q Use a dark field microscope at 5X magnification to inspect the polished optic for scratches and defects over the central 80 mm diameter per the applicable LIGO Component Specification.

LIGO DETECTOR OPTICS
Incoming Inspection Check-off Sheet

Core Optics Polished Substrate

COMMENTS/DISCREPANCIES: (Disposition damage/discrepancies per LIGO Quality Assurance Plan (LIGO M960076-00-P) paragraphs 5.12 and 5.12.1.) _____

SKETCHES:



DISPOSITIONS: _____

		Serial Number:	Specification	Reported Value	✓
				4ITMØ7 - C	
Substrate, Input Test Mass	Surface 1	Surface Figure Over Central 200mm dia.	Spherical, Concave		
		Radius of Curvature Tolerance	14,180m +140m, -1000m	13,640 m	✓
		Astigmatism	< 13nm p-v	4.5 nm	✓
	Surface 2	Surface Figure Over Central 200mm dia.	Nominally Flat		
		Radius of Curvature of the Wavefront	-9,740m +500m, -100m	- 4.95	✓
		Astigmatism	< 15nm p-v	- 2.2	✓
	Surface Errors Surface 1	Low Spatial Frequency Band Central 80mm	$\leq 4.3 \text{ cm}^{-1}$ $\sigma_{\text{rms}} < 0.8\text{nm}$	0.6 nm	✓
		Low Spatial Frequency Band Central 200mm	$\leq 4.3 \text{ cm}^{-1}$ $\sigma_{\text{rms}} < 1.6\text{nm}$	0.9 nm	✓
		High Spatial Frequency Band Central 80 & 200 mm	$\leq 4.3 - 7,500 \text{ cm}^{-1}$ $\sigma_{\text{rms}} < 0.2\text{nm}$	0.17 0.17	✓
	Surface Errors Surface 2	Low Spatial Frequency Band Central 80mm	$\leq 4.3 \text{ cm}^{-1}$ $\sigma_{\text{rms}} < 1.6\text{nm}$	0.7 nm	✓
		Low Spatial Frequency Band Central 200mm	$\leq 4.3 \text{ cm}^{-1}$ $\sigma_{\text{rms}} < 3.2\text{nm}$	1.1 nm	✓
		High Spatial Frequency Band Central 80 & 200 mm	$\leq 4.3 - 7,500 \text{ cm}^{-1}$ $\sigma_{\text{rms}} < 0.2\text{nm}$	0.16 0.17	✓

5.12
4.82

wavefront = - 495

		Specification	Certification	✓
Scratches, Point Defects & Polish Side 1	Scratches	The Total Area of scratches within the central 80mm diameter shall not exceed 25×10^3 square micrometers (width x length). 6,000	Hand Sketch w/dimensions	✓
		The total area of scratches outside the central 80 mm diameter shall not exceed 250×10^3 square micrometers. 15,000	Hand Sketch w/dimensions	✓
	Point Defects	There shall be no more than 10 point defects within the central 80mm diameter.	Hand Sketch w/dimensions	✓
		There shall be no more than 100 point defects on the entire surface. Point defects of radius greater than 25 micrometers are treated like scratches for the purpose of this specification. Point defects of radius less than 2.5 micrometers are disregarded.	Hand Sketch w/dimensions	✓
	Side/Bevel Polish	Sides and bevels shall be polished from a three micrometer grit finish. These surfaces shall appear transparent with no gray, scuffs or scratches visible to the naked eye when viewed in normal room light against a black background.	Inspection Report	✓

LIGO Component Specification Verification Sheet
Input Test Mass

Scratches, Point Defects & Polish Side 2	Specification		Certification		
	Scratches	The total area of scratches shall not exceed 75×10^3 square micrometers over the central 80mm (width x length).	5,000	Hand Sketch w/dimensions	✓
		The total area of scratches outside the central 80 mm diameter shall not exceed 750×10^3 square micrometers.	4,000	Hand Sketch w/dimensions	✓
	Point Defects	There shall be no more than 30 point defects within the central 80mm diameter.		Hand Sketch w/dimensions	✓
		There shall be no more than 100 point defects on the entire optic. Point defects of radius greater than 25 micrometers are treated like scratches for the purpose of this specification. Point defects of radius less than 2.5 micrometers are disregarded.		Hand Sketch w/dimensions	✓
Side/Bevel Polish	Sides and bevels shall be polished from a three micrometer grit finish. These surfaces shall appear transparent with no gray, scuffs or scratches visible to the naked eye when viewed in normal room light against a black background.		Inspection Report	✓	

LIGO Component Specification Verification Sheet
Input Test Mass

ELIASON

LIGO-C990749-00-D



CSIRO

Telecommunications & Industrial Physics

Bradfield Road, West Lindfield
PO Box 218
Lindfield NSW 2070
Tel: 9413.7620
Fax: 9413.7200

24 May 1999

LIGO Document Control Center
C/o Linda Turner
LIGO Project, Mail Code 51-33
California Institute of Technology
Pasadena CA 91125
USA

Certification data – 4ITM07 & 08 (Attention: Garilynn Billingsley)

Please find enclosed certification packages for LIGO Core Optics Components 4ITM07 and 42ITM08, manufactured by CSIRO under purchase order PC167159. An invoice for these components is also enclosed.

Regards

Chris Walsh
Optics and Surface Science

LIGO Certification Report

This Certification Package relates to the following substrate: **Input Test Mass (4 km)**

Serial number: 4ITM07C

The Package consists of the following documents:

1. Printed documents

HABA - LIGO - C - PD:	Certification of Physical Dimensions and Registration Mark location, orientation and dimensions
HABA - LIGO - C - SB:	Certification of Side and Bevel Polish
HABA - LIGO - C - SP:	Certification of Scratches and Point Defects
HABA - LIGO - C - SN:	Certification of Serial Number location, dimensions
HABA - LIGO - C - SF:	Certification of Surface Figure for Sides 1 and 2
HABA - LIGO - C - SL:	Certification of Surface Errors - Low Frequency, for Sides 1 and 2
HABA - LIGO - C - SH:	Certification of Surface Errors - High Frequency, for Sides 1 and 2
Attachment 1	Hard copy print out of LADI data for Side 1 with piston, tilt removed and also for piston, tilt, power, astigmatism removed
Attachment 2	Hard copy print out of LADI data for Side 2 with piston, tilt, removed and also for piston, tilt, power, astigmatism removed
Attachment 2A	Hard copy print out of LADI data for transmitted wave front in measurement configuration where beam enters through side 2, reflects from side 1 and exits through side 2, with piston, tilt removed and also for piston, tilt, power, astigmatism removed
Attachment 3	Hard copy printouts of TOPO 2D data obtained with 2.5X and 40X heads at three central positions (side 1)
Attachment 4	Hard copy printouts of TOPO 2D data obtained with 2.5X and 40X heads at three central positions (side 2)

LIGO Certification Report

2. Electronic data

Surface maps for sides 1 and 2 are available at the CSIRO ftp site under the following file names:

LADI data:	4ITM7C1.zip (Side 1)	4ITM7C2.zip (Side 2) 4ITM7C2A.zip (wave front)
TOPO data: (2.5X)	T24IM71A.asc (Side 1)	T24IM72A.asc (Side 2)
	T24IM71B.asc	T24IM72B.asc
	T24IM71C.asc	T24IM72B.asc
(40X)	T44IM71A.asc	T44IM72A.asc
	T44IM71B.asc	T44IM72B.asc
	T44IM71C.asc	T44IM72C.asc

1	Substrate Type:	4ITM
2	Serial Number:	4ITM0
3	Physical quantity certified:	Physical Dimensions and Registration Mark
4	LIGO specification reference:	D960803-B-D
5	CSIRO measurement/inspection procedure reference:	HABA-LIGO-M-PD
6	Variations to the measurement/inspection procedure: (indicate Yes/No and attach separate sheet if Yes)	No
7	CSIRO Log Book Reference	LN00028 p.31
8	Team member responsible for measurement/inspection:	R Yin
9	Measurement/inspection results reviewed by:	C Sona

10. Results

[Measurement errors ($\pm 1\sigma$) shown only where they are comparable to tolerances specified or when measurement is within 2σ of boundary of acceptability]

Physical Quantity	Result
Diameter	250.98 mm
Cylindricity	0.01 mm
Thickness (maximum - for FM, RM, ETM) (minimum - for BS)	99.99 mm
Bevel as per drawing (height, angle):	(S1) Height:2.26 mm Angle: 45°01' (S2) Height:2.21 mm Angle: 44°50'
Wedge angle:	1°12'
Location of registration mark (\pm angle with respect to minimum part thickness):	0°00'
Location of other 3 marks (with respect to registration mark at minimum thickness)	89°58', 180°00', 270°00'
Registration mark dimensions (OK/ not OK)	OK

11. Certification

The measurements and inspection data presented in this report were obtained using the procedures outlined in the relevant CSIRO procedures document (sec. 5). These results have been reviewed against the LIGO specifications (sec. 4). Taking into account the variations (if any) from these measurement procedures noted in sec.6, CSIRO certifies the substrate to comply with the LIGO specification for this physical quantity.

Project Manager:

Walsh

Chris Walsh

Date:

23 May 99

LIGO Certification Report Side and Bevel Polish

1	Substrate Type:	4ITM
2	Serial Number:	4ITM07
3	Physical quantity certified:	Side and Bevel Polish
4	LIGO specification reference:	E960093-C-D
5	CSIRO measurement/inspection procedure reference:	HABA-LIGO-M-SB-A
6	Variations to the measurement/inspection procedure: (indicate Yes/No and attach separate sheet if Yes)	No
7	CSIRO Log Book Reference	LN00062
8	Team member responsible for measurement/inspection:	E Pavlovic
9	Measurement/inspection results reviewed by:	J Seckold

10. Results

Defects, if any, in the side and bevel polish compared to the LIGO specification (4 above) are detailed below (*team member to note defects here; if none seen, note "no defects observed"*).

No defects observed

11. Certification

The measurements and inspection data presented in this report were obtained using the procedures outlined in the relevant CSIRO procedures document (sec. 5). These results have been reviewed against the LIGO specifications (sec. 4). Taking into account the variations (if any) from these measurement procedures noted in sec.6, CSIRO certifies the substrate to comply with the LIGO specification for this physical quantity.

Project Manager:

Chris Walsh
23 May 99

Chris Walsh

Date:

1	Substrate Type:	4ITM
2	Serial Number:	4ITM07
3	Physical quantity certified:	Serial Number and location
4	LIGO specification reference:	E960093-C-D
5	CSIRO measurement/inspection procedure reference:	HABA-LIGO-M-SN-A
6	Variations to the measurement/inspection procedure: (indicate Yes/No and attach separate sheet if Yes)	No
7	CSIRO Log Book Reference	LN00062
8	Team member responsible for measurement/inspection:	E Pavlovic
9	Measurement/inspection results reviewed by:	J Seckold

10. Results

Quantity inspected	Result of Inspection (OK / not OK)
Location of serial number as per drawing (sec. 4)	OK
Orientation of serial number as per drawing (sec. 4)	OK
Height of lettering	OK

11. Certification

The measurements and inspection data presented in this report were obtained using the procedures outlined in the relevant CSIRO procedures document (sec. 5). These results have been reviewed against the LIGO specifications (sec. 4). Taking into account the variations (if any) from these measurement procedures noted in sec.6, CSIRO certifies the substrate to comply with the LIGO specification for this physical quantity.

Project Manager:

Chris Walsh
23 May 99

Chris Walsh

Date:

1	Substrate Type:	4ITM
2	Serial Number:	4ITM07
3	Physical quantity certified:	Scratches and Point Defects
4	LIGO specification reference:	E960093-C-D
5	CSIRO measurement/inspection procedure reference:	HABA-LIGO-M-SP-A
6	Variations to the measurement/inspection procedure: (indicate Yes/No and attach separate sheet if Yes)	No
7	CSIRO Log Book Reference	LN00062
8	Team member responsible for measurement/inspection:	E Pavlovic
9	Measurement/inspection results reviewed by:	J Seckold

10. Results

	Numbers of point defects		Total Area of scratches (square micrometres)	
	Inside central 80 mm	Entire surface (235 mm)	Inside central 80 mm	Outside central 80 mm (235 mm)
Surface 1	Nil	Nil	< 6,000	< 15,000
Surface 2	Nil	Nil	< 5,000	< 4,000

11. Certification

The measurements and inspection data presented in this report were obtained using the procedures outlined in the relevant CSIRO procedures document (sec. 5). These results have been reviewed against the LIGO specifications (sec. 4). Taking into account the variations (if any) from these measurement procedures noted in sec.6, CSIRO certifies the substrate to comply with the LIGO specification for this physical quantity.

Project Manager:

Chris Walsh
24 May 99

Chris Walsh

Date:



Thin

4ITM07
SIDE 1

1003

~~1006~~

1004

1000



 Thin

1000

1000
1000

4ITMC7 SIDE 2

1	Substrate Type:	4ITM
2	Serial Number:	4ITM07
3	Physical quantity certified:	Surface Figure
4	LIGO specification reference:	E960093-C-D
5	CSIRO measurement/inspection procedure reference:	HABA-LIGO-M-SF-A
6	Variations to the measurement/inspection procedure: (indicate Yes/No and attach separate sheet if Yes)	No. Data files for transmitted wavefront represent two passes
7	CSIRO Log Book Reference	LLN/0137-02 (Bk 5) p.103
8	Team member responsible for measurement/inspection:	E Pavlovic
9	Measurement/inspection results reviewed by:	B Oreb

10. Results

	Radius of Curvature in km	Astigmatism (nm)	Electronic data file reference
Surface 1	13.64	4.5	4ITM7C1.zip
Surface 2	-14.59	-2.2	4ITM7C2.zip
Wavefront*	-4.95		4ITM7CT.zip

* Measured as per the test procedure in E960093-C-D.

Hardcopies of the phase maps are attached to this certification as part of Attachment 1 for Side 1 and Attachment 2 for Side 2. Phase map data is stored in electronic format at the CSIRO ftp site under the filenames shown in the third column.

11. Certification

The measurements and inspection data presented in this report were obtained using the procedures outlined in the relevant CSIRO procedures document (sec. 5). These results have been reviewed against the LIGO specifications (sec. 4). Taking into account the variations (if any) from these measurement procedures noted in sec.6, CSIRO certifies the substrate to comply with the LIGO specification for this physical quantity.

Project Manager:

Chris Walsh

Chris Walsh

Date:

24 May 99

1	Substrate Type:	4ITM
2	Serial Number:	4ITM07
3	Physical quantity certified:	Surface Errors - Low Spatial Frequency
4	LIGO specification reference:	E960093-C-D
5	CSIRO measurement/inspection procedure reference:	HABA-LIGO-M-SL-A
6	Variations to the measurement/inspection procedure: (indicate Yes/No and attach separate sheet if Yes)	No
7	CSIRO Log Book Reference	LLN/0137-02, Bk. 5, p.103
8	Team member responsible for measurement/inspection:	E Pavlovic
9	Measurement/inspection results reviewed by:	B Oreb

10. Results

	Low Frequency Surface Errors (nm)	
	80 mm aperture	200 mm aperture
Surface 1	0.6	0.9
Surface 2	0.7	1.1

Hardcopies of the phase maps over the central 200 mm with piston, tilt, power and astigmatism removed are attached to this certification in Attachment 2 for Side 1 and Attachment 2 for Side 2.

11. Certification

The measurements and inspection data presented in this report were obtained using the procedures outlined in the relevant CSIRO procedures document (sec. 5). These results have been reviewed against the LIGO specifications (sec. 4). Taking into account the variations (if any) from these measurement procedures noted in sec.6, CSIRO certifies the substrate to comply with the LIGO specification for this physical quantity.

Project Manager:

Chris Walsh

Chris Walsh

Date:

24 May 99

1	Substrate Type:	4ITM
2	Serial Number:	4ITM07
3	Physical quantity certified:	Surface Errors - high spatial frequency
4	LIGO specification reference:	E960093-C-D
5	CSIRO measurement/inspection procedure reference:	HABA-LIGO-M-SH-A
6	Variations to the measurement/inspection procedure: (indicate Yes/No and attach separate sheet if Yes)	No
7	CSIRO Log Book Reference	LLN/091
8	Team member responsible for measurement/inspection:	F Lesha
9	Measurement/inspection results reviewed by:	C Walsh

10. Results

10.1 Surface errors in nanometres averaged over sampling locations within central 80 mm:

Side 1: 0.17

Side 2: 0.16

10.2 Surface errors in nanometres averaged over all sampling locations on surface:

Side 1: 0.17

Side 2: 0.17

10.3 Surface errors in nanometres at different positions A through H on surface:

	A	B	C	D	E	F	G	H
Surface 1	0.18	0.17	0.18	0.18	0.16	0.19	0.15	0.15
Surface 2	0.15	0.15	0.17	0.16	0.16	0.19	0.18	0.18

Two - dimensional surface maps at three central locations are available at the CSIRO ftp site under filenames of the form TMXX0YZA.asc, where M is the objective used (M=2 for 2.5X, 4 for 40X), XX is the substrate type, 0Y is the number, Z = 1 or 2 is the side and A = A, B, C, ... is the sampling position. Hard copies of the data are at Attachment 3 (Side 1) and Attachment 4 (Side 2).

11. Certification

The measurements and inspection data presented in this report were obtained using the procedures outlined in the relevant CSIRO procedures document (sec. 5). These results have been reviewed against the LIGO specifications (sec. 4). Taking into account the variations (if any) from these measurement procedures noted in sec.6, CSIRO certifies the substrate to comply with the LIGO specification for this physical quantity.

Project Manager:

Walsh

Chris Walsh

Date:

24 May 99.

LADI CERTIFICATION DATA

Title: 4ITM071

Date: 12/24/98

Diameter: 200 mm

Astig: 4.5 nm

Power: 367.3 nm

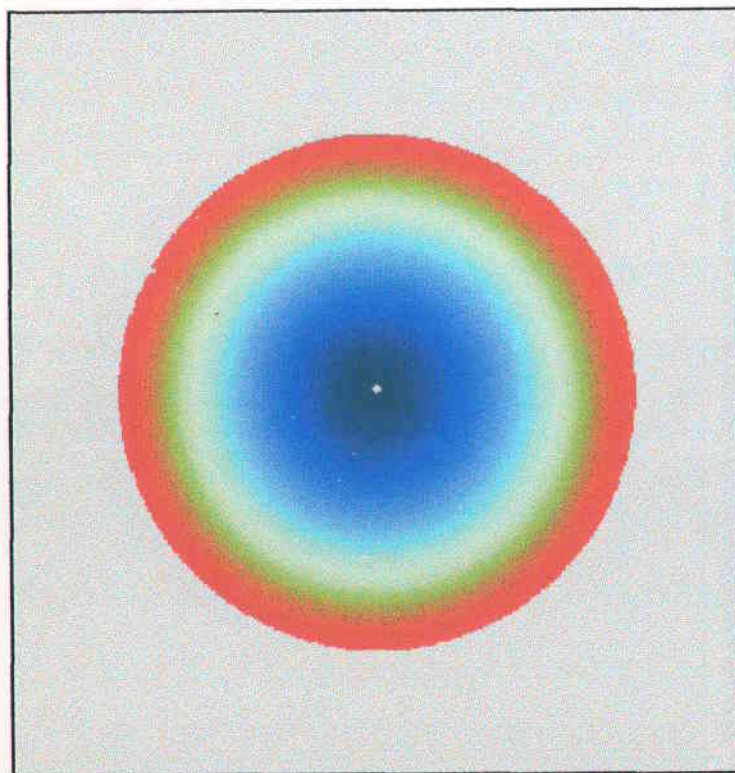


CSIRO

PV: 10.9 nm

RMS: 0.9 nm

Tilt Removed



um

0.2

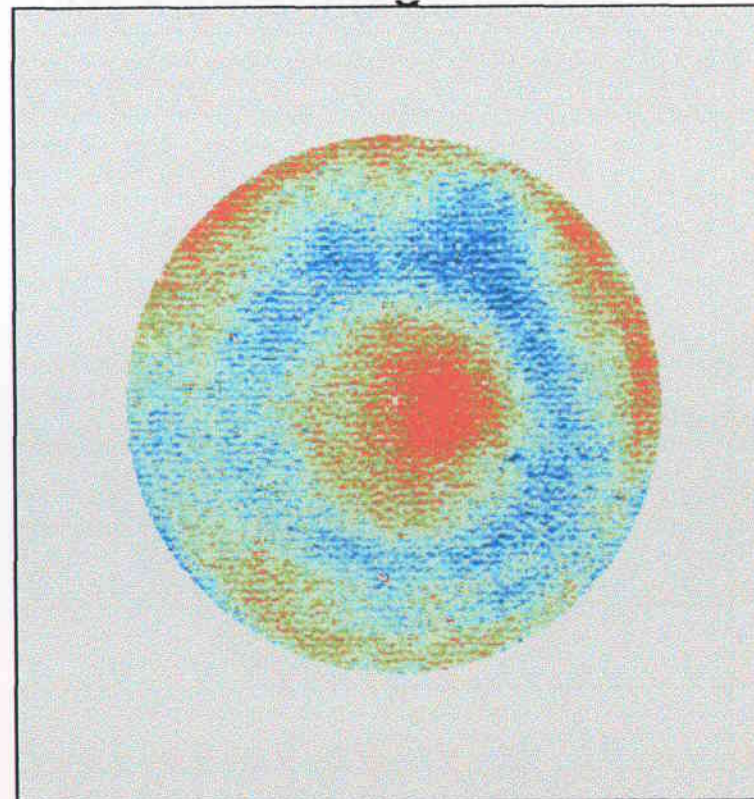
0.1

0.0

-0.1

-0.2

Tilt/Power/Astig Removed



nm

6.3

4.0

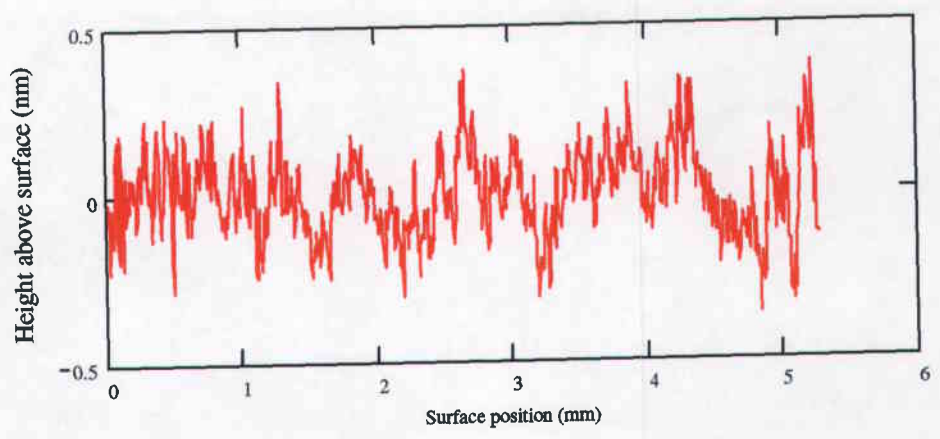
2.0

0.0

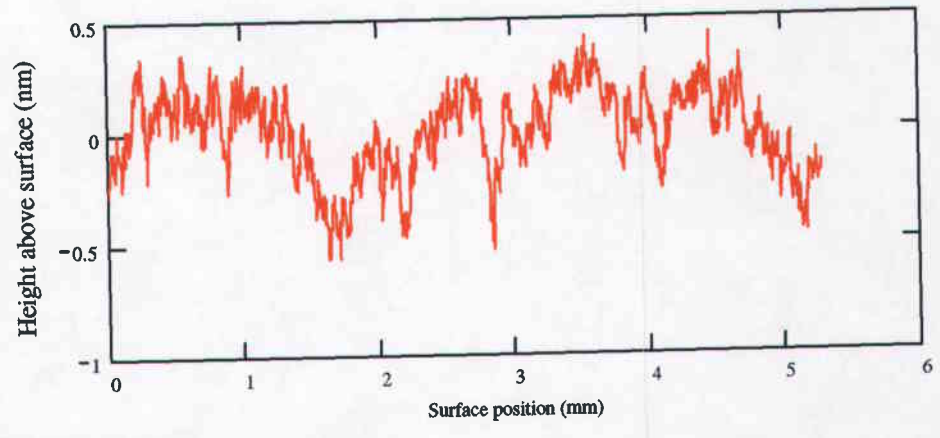
-2.0

-4.7

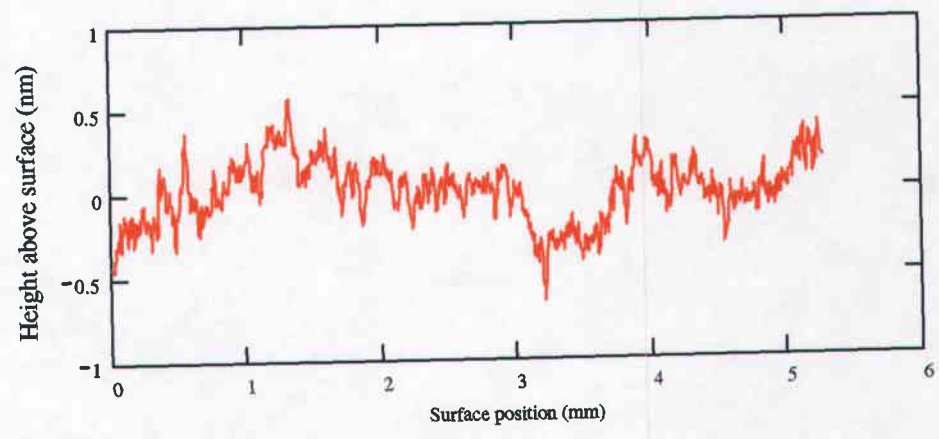
Attach 1



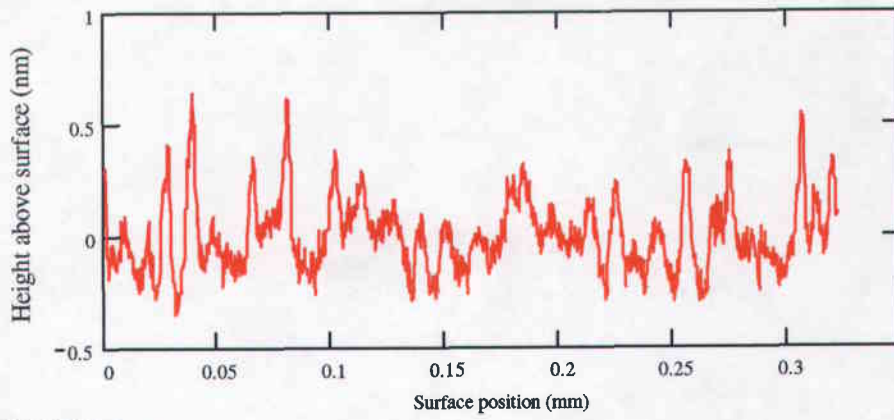
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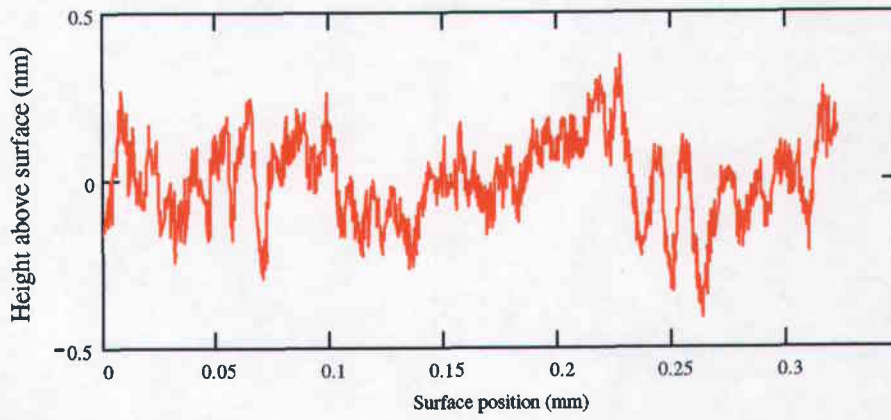
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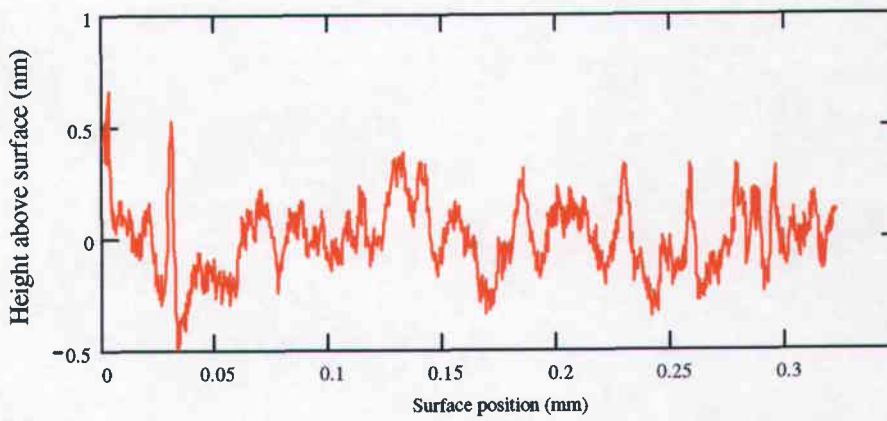
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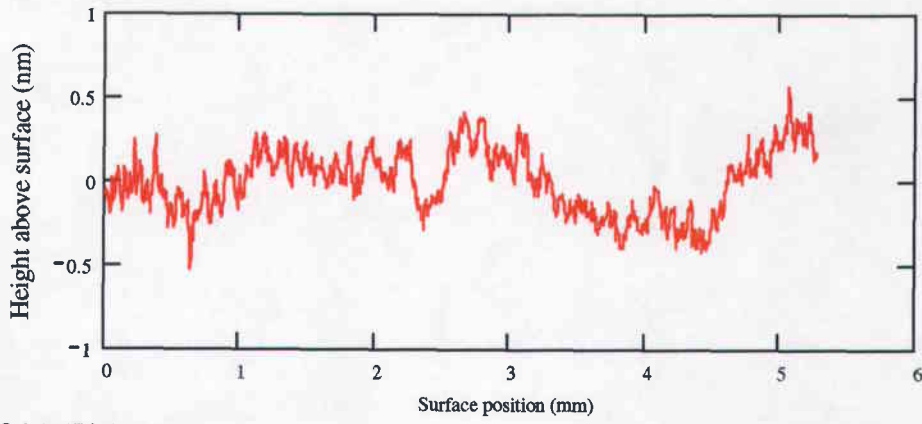
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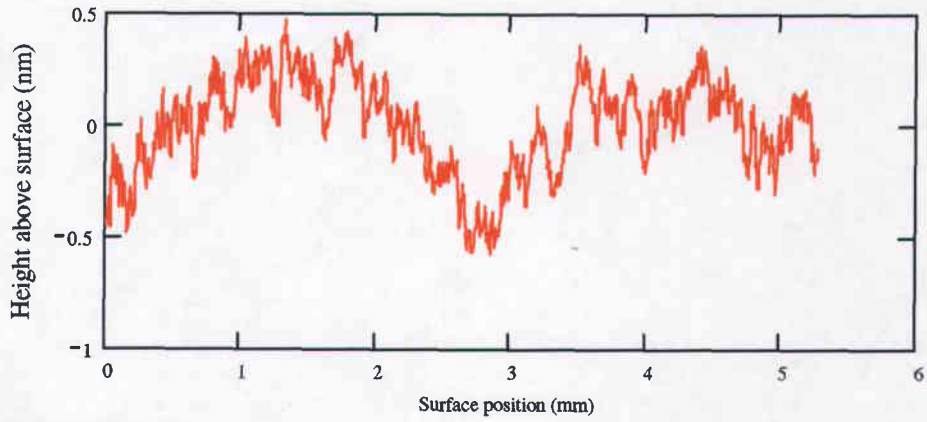
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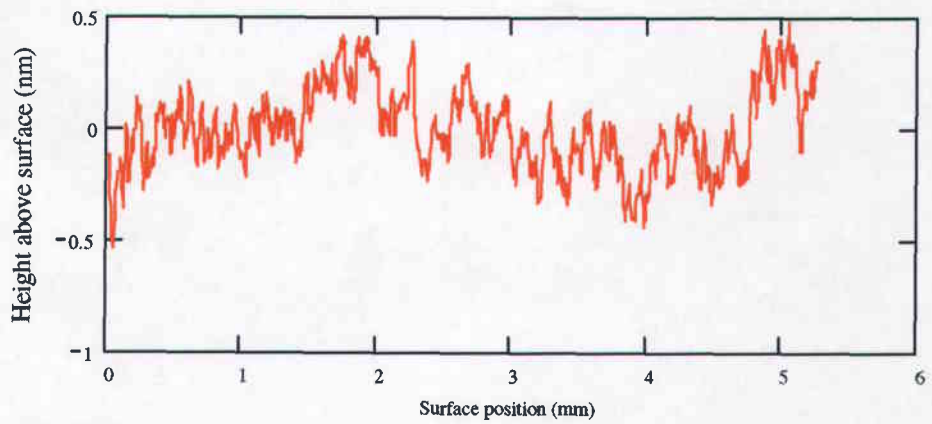
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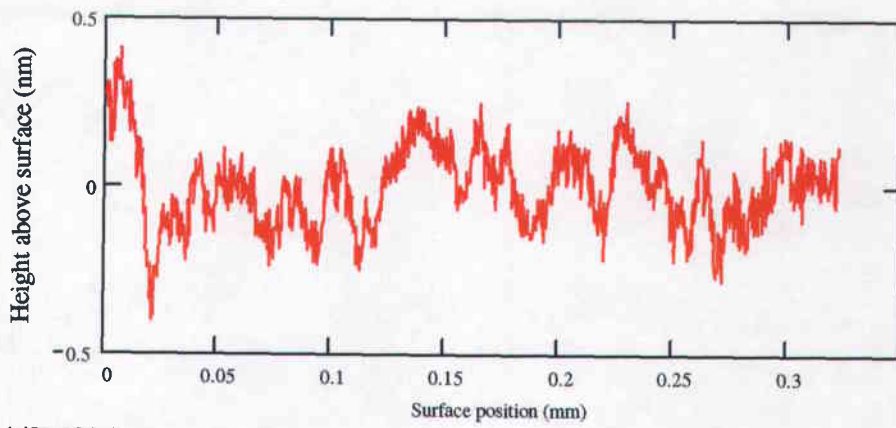
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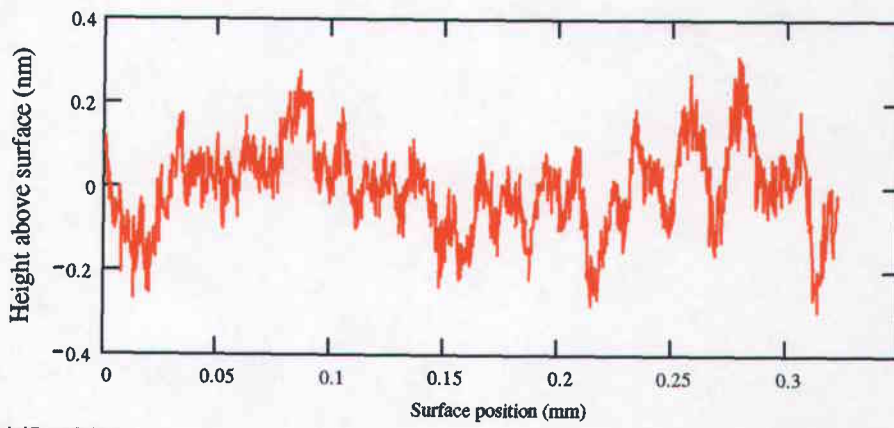
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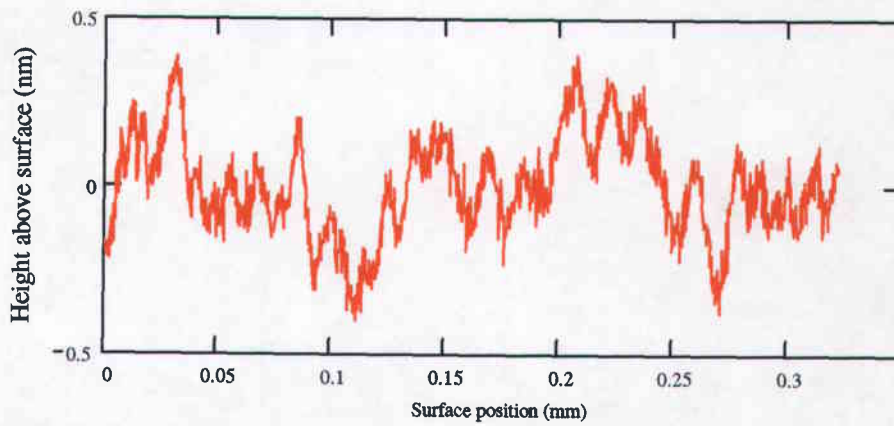
T24IM72C.asc



T44IM72A.asc



T44IM72B.asc



T44IM72C.asc

LINDA STOHR CHB, INC
 11099 S LA CIENEGA BLVD W258
 LOS ANGELES, CA 90045
 (310)216-6446

DATE: 6/03/99 OUR REF. NO.: 9230

THE MERCHANDISE DESCRIBED BELOW
 WILL BE ENTERED AND/OR FORWARDED
 AS FOLLOWS:

CARRIER NZ		LOCATION YSSO AIR NEW ZEALAND		ORIGIN/DESTINATION PORT	
B/L OR AWB NO. MULTI	ARR/DEPT. DATE 5/29/99	FREE TIME EXP. 0/00/00	LOCAL DELIVERY OR TRANSFER BY (DELIVERY ORDER ISSUED TO) CUSTOM AIR TRUCKING, INC		
LINDA STOHR CHB, INC		HOUSE NO.	ENTRY-B/L NO. NLS 0000230-5	CUST. REF. NO.	
FOR DELIVERY TO CA INSTITUTE OF TECHNOLOGY 1201 E CALIFORNIA BLVD PASADENA, CA 91125			ROUTE		

NO. OF PKGS.	DESCRIPTION OF ARTICLES, SPECIAL MARKS & EXCEPTIONS	WEIGHT	DO NOT USE
5	FUSED SILICA FREIGHT PREPAID BY CENTRA WORLDWIDE PWD# 10022 MASTER AIRWAY BILL# 08691672103 HOUSE AIRWAY BILL#1 21031 #02 21032 RM05 RM07 42ITM08 RM06 4ITM07	331 Lb 4123130 219 265 Jerron	

INLAND FREIGHT →

PREPAID / COLLECT
 Prepaid

Received in Good Order
 By: *[Signature]*

PER: *[Signature]*
 (310)216-6446

Rec'd complete
 6-08-99
[Signature]

DELIVERY CLERK: DELIVER
 TO CARRIER SHOWN ABOVE

3186

COATED



Research Electro-Optics Inc.

CERTIFICATE OF CONFORMANCE

Section 3.14/REO QC Manual, Q-001, Doc. No. V:QA:REO 014, Rev. "B", 09/13/96

Certificate of Conformance from: **Research Electro-Optics (REO) Inc.**
1855 South 57th. Court
Boulder, Colorado 80301
(303) 938-1960, Fax (303) 447-3279

Research Electro-Optics (REO), Inc. hereby certifies that the items listed below have been inspected and tested to the extent necessary to conform with all the requirements of the noted Purchase Order, drawing, and applicable specification(s). Inspection and test data are on file at our facility and will be furnished to customer upon request.

• Date of Shipment	<u>06/25/99</u>
• Customer Name	<u>California Inst. of Tech / PC162519/CONO5</u>
Purchase Order No.	
• Customer Part	<u>LIGOE980067</u>
Number & Revision	
• Part Description	<u>INPUT TEST MASS 4K, COATED</u>
• REO Job No.	<u>OPT05831-32</u> Run No: <u>OX993/OX994/981</u>
• Qty. Shipped/Lot No.	<u>2 PCS / M1002-03</u>

Test data (included)

Comments: 4 ITM
SN# 07 / SN# 08

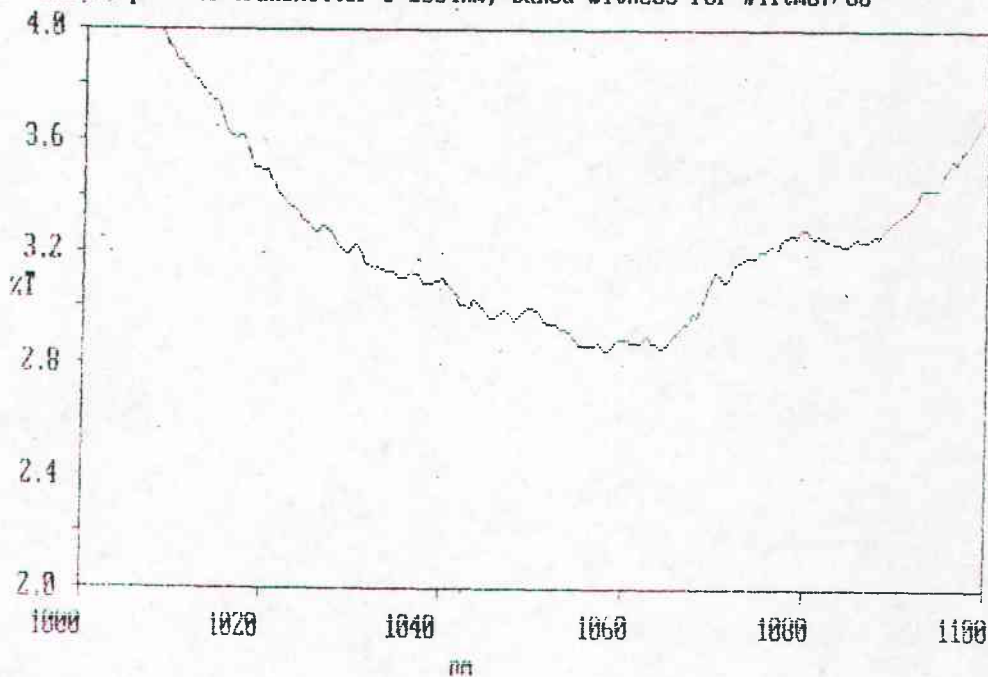
INCLUDED 2 SAMPLE SLIDES

Certified by:	<u></u>	<u>6/25/99</u> Date
Verified by:	<u></u> Quality Assurance Engr/Tech	<u>25 June 99</u> Date

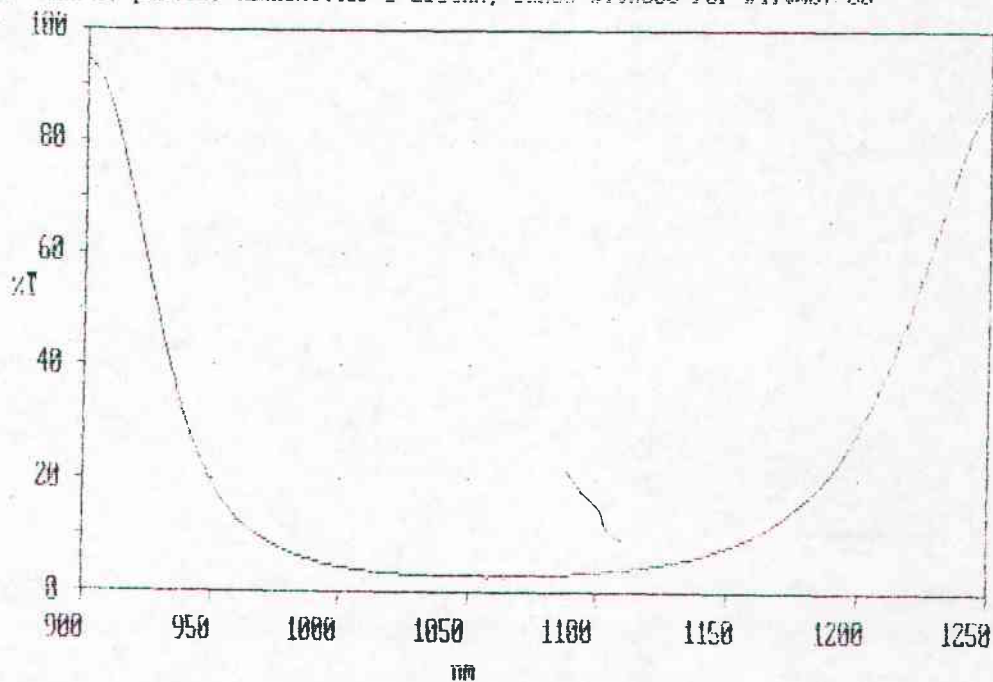
NOTE

Certificate must accompany the package to be shipped or attached to the outside of the same box to which the "Packing Slip" envelope is attached.

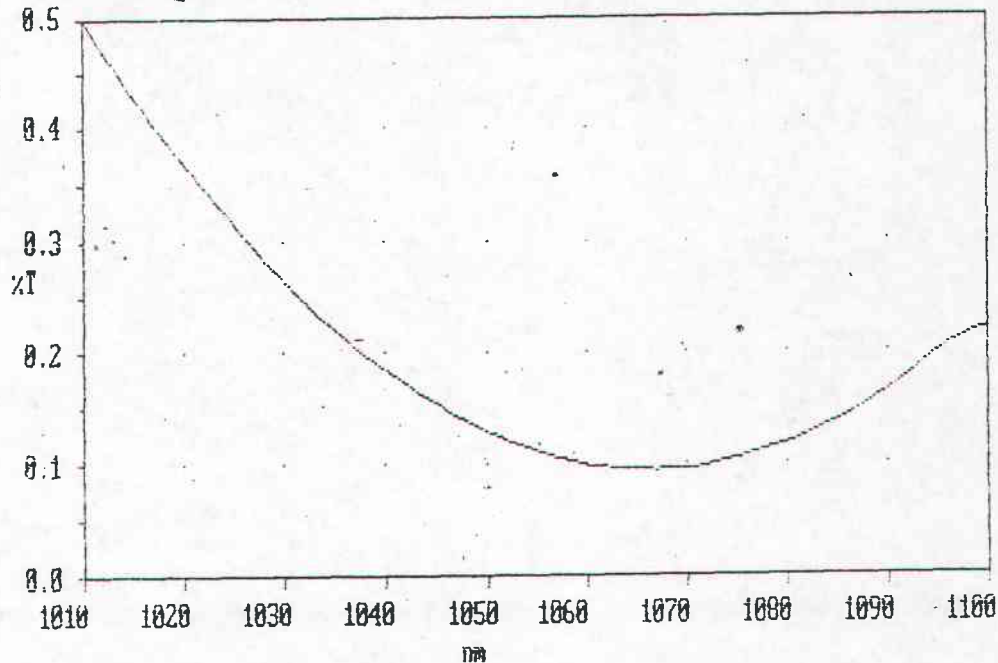
X: user002; 1250.0 - 900.0 nm; pts 701; int 0.50; ord 2.8588 - 94.810 %T
Inf: 0X993, partial transmitter @ 1064nm, baked witness for #4itm07/08



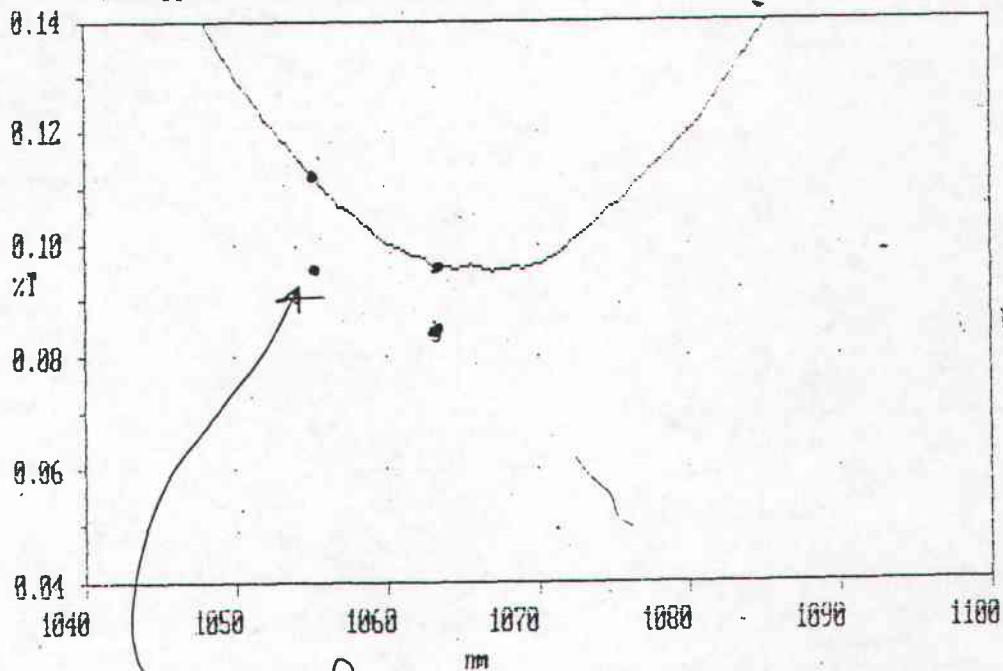
X: user002; 1250.0 - 900.0 nm; pts 701; int 0.50; ord 2.8588 - 94.810 %T
Inf: 0X993, partial transmitter @ 1064nm, baked witness for #4itm07/08



X: user003; 1100.0 - 1000.0 nm; pts 201; int 0.50; ord 0.0954 - 0.6264 %T
 Inf: OX994, 600ppm AR @ 1064nm, witness piece for 4itm07,00 baked



X: user003; 1100.0 - 1000.0 nm; pts 201; int 0.50; ord 0.0954 - 0.6264 %T
 Inf: OX994, 600ppm AR @ 1064nm, witness piece for 4itm07,00 baked

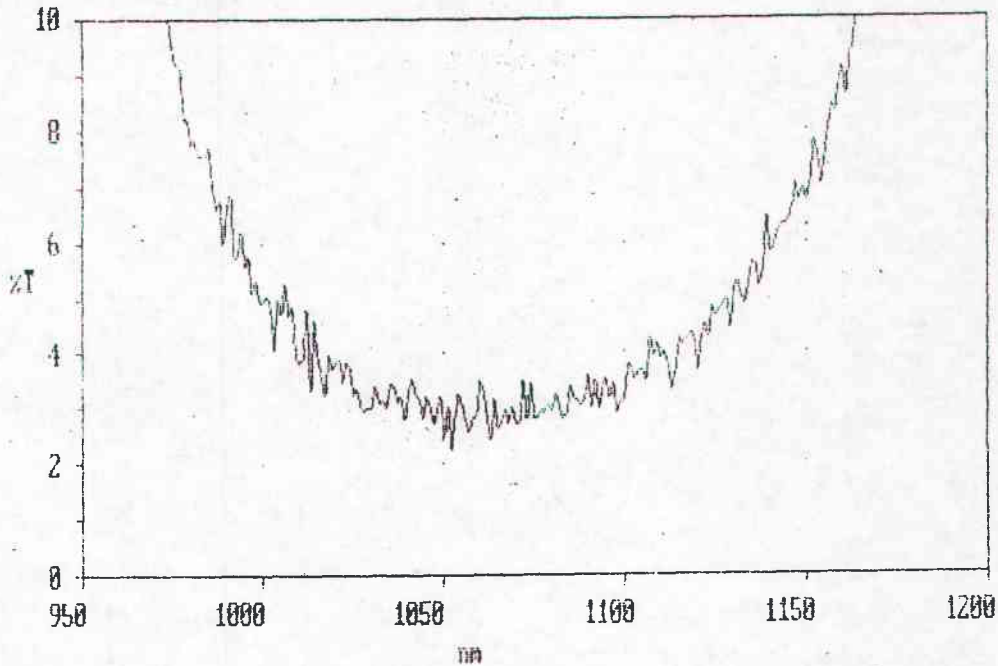


measured
 with laser
 @ 1053 nm
 $R = 934 \text{ ppm}$

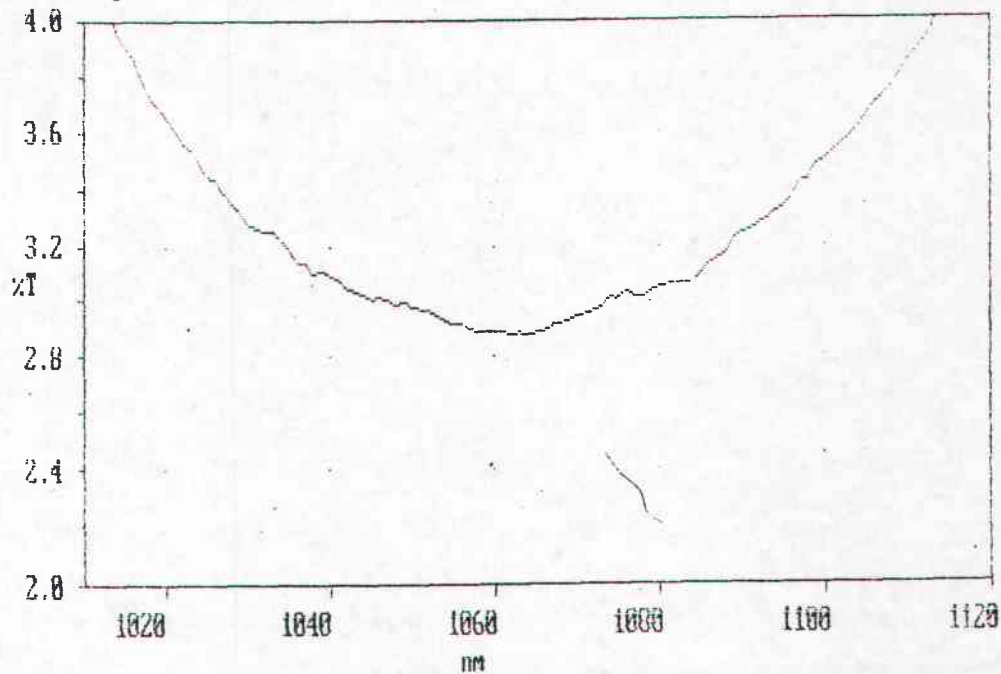
\therefore Level @
 1064 nm
 $R = 800 \text{ ppm}$

Scans for
slides

X: user001; 1200.0 - 950.0 nm; pts 251; int 1.00; ord 2.2763 - 24.452 %T
Inf: ox981 partial transmitter after processing.

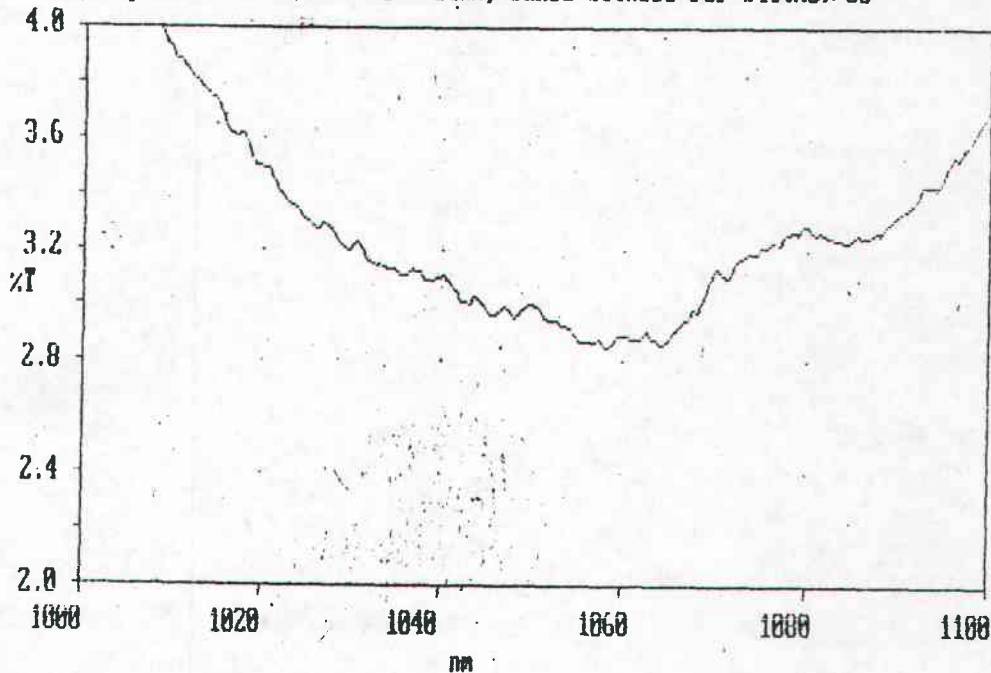


X: user001; 1200.0 - 950.0 nm; pts 251; int 1.00; ord 2.8810 - 22.444 %T
Inf: ox981 partial transmitter after processing.



Scans for
slides

X: user002; 1250.0 - 900.0 nm; pts 701; int 0.50; ord 2.0500 - 94.810 %T
Inf: 0X993, partial transmitter @ 1064nm, baked witness for #4itm07/00



X: user002; 1250.0 - 900.0 nm; pts 701; int 0.50; ord 2.0500 - 94.810 %T
Inf: 0X993, partial transmitter @ 1064nm, baked witness for #4itm07/00

