

4ITM02-C

LIGO-T990152-00-D

BLANK

A. DCN: LIGO- T970032-00-D LIGO DETECTOR OPTICS
B. LIGO S/N: IMØ2 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: Herapus / 500 1652
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.: Melt M.F.F 8517
I. Date Received at Caltech: 10-06-97

J Verify glass manufacturer's ^{inspection report} ~~Certification~~ against LIGO Component Specification No. E 96095-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 4.28 in 108.8 mm

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

Inspect By: [Signature] Date Inspected: 10-06-97

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.

LIGO Component Specification Verification Sheet

Mirror Blanks, Input Test Mass

		Serial Number: <i>IMØ2</i>	Specification	Reported Value	✓
		Mirror Blanks, Input Test Mass Requirements		Physical Dimensions	LIGO-D960794
Diameter	256mm +1.0mm, -0mm			256.6mm	✓
Thickness	108mm +1.0mm, -0mm			108.8mm	✓
Chamfer	2.0mm Max 2pl			minimal	✓
Clear Aperture	Central 235mm				-
Material	Fused Silica #7980 <i>supplied by R2?</i>			Certification	✓
Registration Mark	"Top" of Optic, 80mm Arrow Points to Side 1			Certification	none
Witness Sample	25mm dia. x 25mm cylindrical			<i>shipped separately</i>	✓
Witness Sample Map				Map Attached	-
Defect Depth	< 0.5mm			Hand Sketch w/location & dim.	No
Homogeneity Within the Central 80mm	$\leq 5.0 \times 10^{-7}$ p-v $\lambda = 632.8\text{nm}$			Interferogram Homogeneity Map	No
Homogeneity Within the Central 200mm	$\leq 2.5 \times 10^{-6}$ p-v $\lambda = 632.8\text{nm}$			Interferogram Homogeneity Map	No
Homogeneity Data	ASCII Format			PC Compatible 3½ in. Disk	No
Birefringence Within the Central 80mm	≤ 1 nm/cm			Certification, Birefringence Map	No
Birefringence Within the Central 200mm	≤ 5 nm/cm			Certification, Birefringence Map	No
Bubble & Inclusion within the clear aperture. Max. Inclusion Diameter	Total $\leq 0.03\text{mm}^2$ Per 100cm^3 of Glass. $\leq 0.1\text{mm}$			Hand Sketch w/location & dim.	No
Absorption	2 ppm/cm $\lambda = 1.06\mu\text{m}$			Certification	No
Striae within the Clear Aperture	Grade A per MIL-G-174			Inspection Report	No

Blk_ITM.doc

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 8561
Marking : 960095-IM10' 2 = BN 5394

Diameter : 256,7 mm
CA Diameter : $\varnothing 200 \text{ mm} = 1,53 \times E^{\circ}$
Thickness : 108,9 mm
Edge : 0,3 - 0,5 mm
Parallelism : < 0,08 mm
Roughness : ground
 R_a : 1,08 μm
 R_t : 8,86 μm
Bubble class : 0 ; none bubbles
Birefringence : CA $\varnothing 200 \text{ mm} \leq 5 \text{ nm/cm}$
Homogeneity : see Interferogram
Striae Grade : A
Granularity : none
Remark : Test Sample ($\varnothing 25 \times 25 \text{ mm}$) with the same marking

POL - Qualitätsprüfung Optik

Date : 15.08.1997

Inspector : O.Dauth Munk

Heraeus
QUARZGLAS

POL-QW

Order Nr.: 94908401 Pos.: 1

Ø 256,7 mm x 108,9 mm

Quality: Suprasil 312

Plate No.: 960095-1M2/5394

Date: 15.8.97

Inspector: 



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

TBCS=

mm²
/100cm³

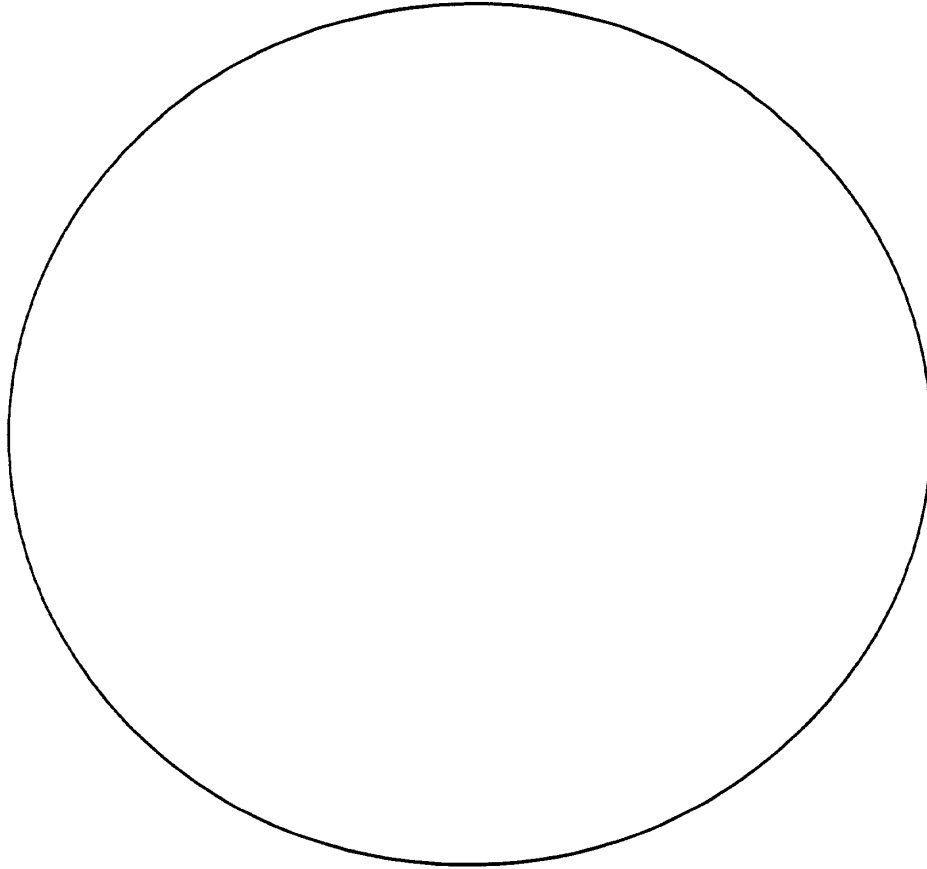
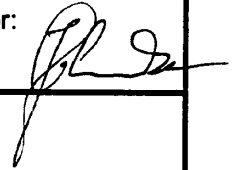
Heraeus
QUARZGLAS

POL - QW

Order No.: 94908401 Pos.: 1
Ø 256,7 mm x 108,9 mm
Plate No.: 960095-142 / 5394
Residual strain- Report

Date: 15. 8. 97

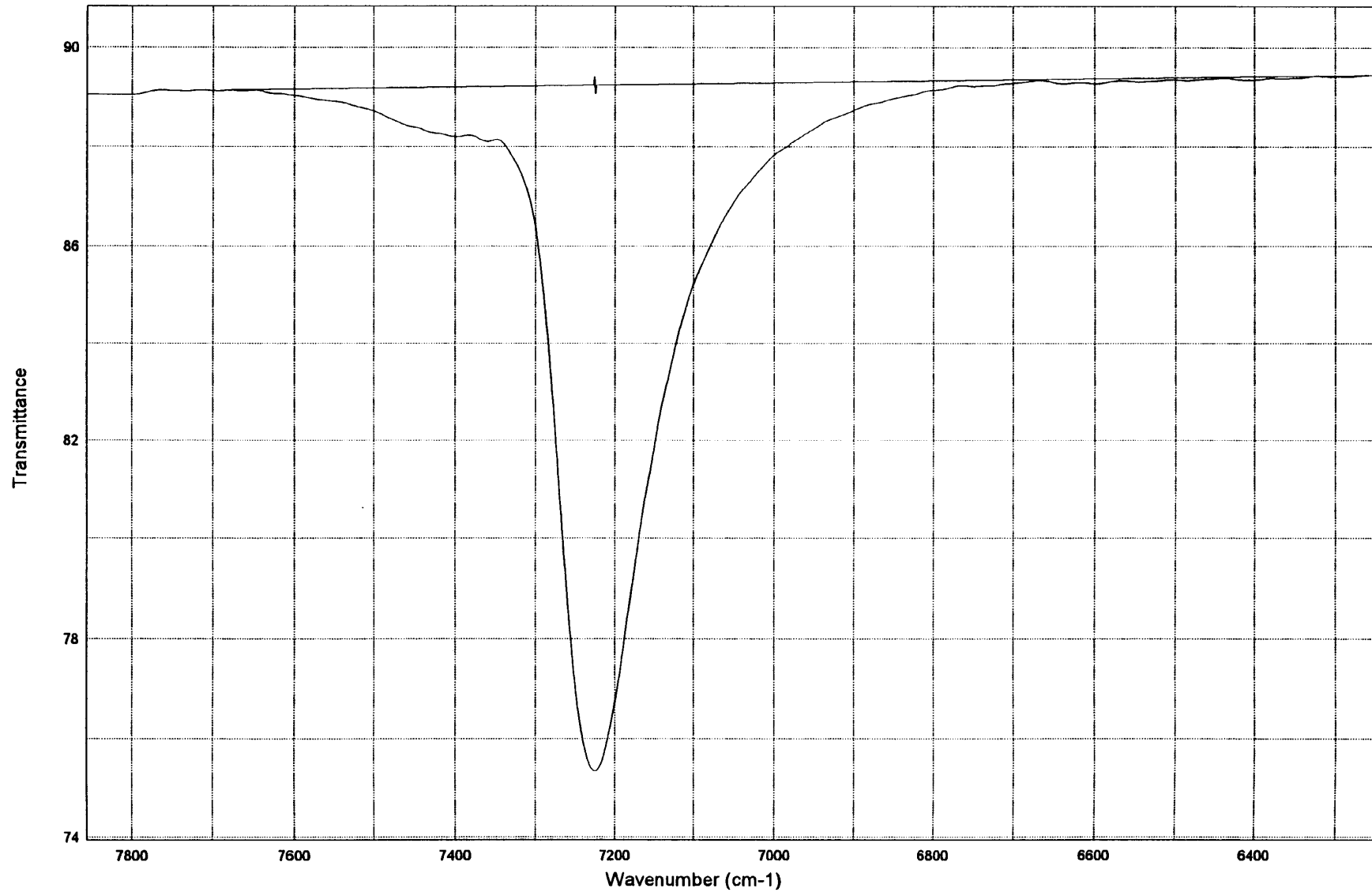
Inspector:



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

I0=89.2368 , I1=75.3555 at x=7225 OH-content: 293.7 ppm

MEASURE NO. : 5394
DATE : 02.09.1997 TIME : 10:40
MEASURE START : 10000 1/cm
MEASURE END : 2000 1/cm
OP-DISK-PATH LENGTH : Ko-200-PL: 4.0 cm / Order No.: 9999 9999 / Material: Su 311—OH-content: 293.7 ppm at x=7225



Heraeus
QUARZGLAS

POL-QW

Meßwellenlänge 632.8 nm

Datum: 02.08.97

Bediener: Rt

ID: 539400

Nr.:

HQS-Auftr.-Nr.: 98492867

Kunde: HAI

Produkt: LIGO

Pos.-Nr.: 1

Auftrags-Nr.:

Kommentar: 960095-im-02

Probendicke: 109.0 mm

Probendurchm.: 280.0 mm

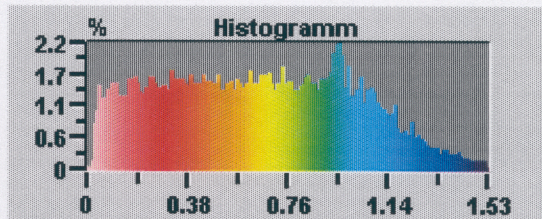
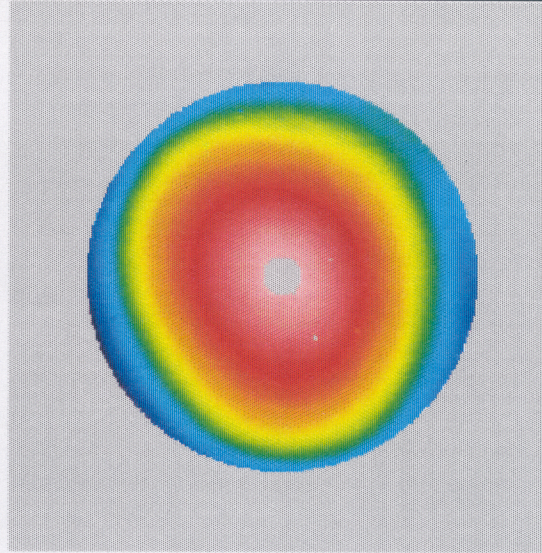
CA-Durchm.: 200.0 mm

Bilddurchm.: 200.3 mm

Mittelpunkt: (0.0mm,0.0mm)

Radius: 100.1mm

Punkte: 69729



Sub. Terme	Betrag	Winkel
X Tilt	0.2656	-127.0907
Fokus	0.5917	
Astigm.	0.1546	-75.8195
Koma	0.0846	33.8858
SA3	-0.0089	

Phasendaten

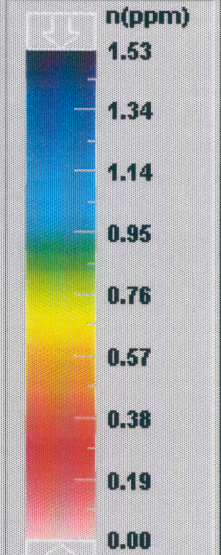
Einheit n(ppm)

PV: 1.53

RMS: 0.349

Scale: 0.5

Kontrast

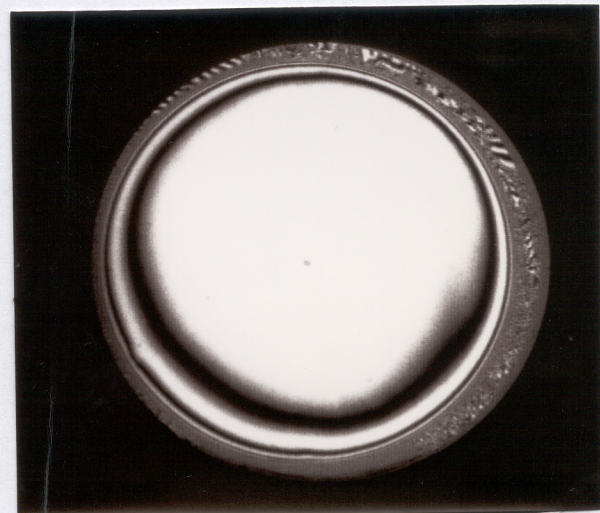


Reset

OberG 1.526

UnterG 0.000

Datei: 539400.tif, 02.08.97, 11:05



Heraeus Amersil Inc
 3473 Satellite Blvd.
 Duluth, GA 30136

Heraeus AMERSIL

Pick Ticket

Sales Order #: 5001652
 Delivery #: 30035153

Terms: FOB Duluth
 Customer PO # pc208421

65" x 25" x 5"

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

ref quote# 9607054

Order Entered By: DANB
 Salesman: 00000020 MARC SCHNEIDER

7846273 |

Route: ~~UPS002 UPS Blue 2 Day PPA~~
 Actual Route: Lynden Overnight

LINE ITEM	PART NUMBER	DESCRIPTION	UNIT MEAS	SHIP DATE	PICK QTY	ACTUAL PICK QTY	PICK LOCATION	UNIT PRICE
000002	50784	DISC, SUP 312, G, 256 X 108 order from HQS \$43,910 ea. dlrvy approx. 12 months.....part includes a witness aproximately 25mm diameter X 25mm thick from a nearby portion of the ingot prior to hot form flow out IMØ2	EA	10/07/1998	11.000	11		

Special Packaging: _____ @ \$ _____ a piece

of Shipping Cartons: 1

Total Weight of Shipment: 356

Insurance Charge: _____ Freight Charge: _____

Picked By: DI / pm

Date: 10-1-97

SUBSTRATE

A. DCN: LIGO-T970032-01-D

LIGO DETECTOR OPTICS

B. LIGO S/N: 4ITM02-C

Incoming Inspection Check-off Sheet
Core Optics Polished Substrate

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.: PC 167159 D. Substrate Polisher: CSIRO

E. Core optic Material: BS / FM / 2ITM (4ITM) / ETM / RM F. Date Received: 12-14-98

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 From FTP site

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 type="checkbox"/>	Inspection of material diameter.	Diameter	_____ in	<u>250.97</u> mm
<input type="checkbox"/>	Inspection of material thickness	Thickness	_____ in	<u>100.008</u> mm
<input 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.

R Sign and date original packing slip (shipper) and distribute per paragraph 3.R. *No shipper*

Inspection By: *Steven Tison* Date Inspected: *12-16-98*

Reviewed and/or accepted by:

Cognizant Engineer: _____ Date: _____

LIGO QA Officer or Designee: _____ Date: _____

FM300

Figure 1

**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:

See vendor supplied sketches (esp. side 2)

DISPOSITIONS: _____

Substrate, Input Test Mass		Serial Number:	Specification	Reported Value	✓
				AITM02-C	
Surface 1	Surface Figure Over Central 200mm dia.		Spherical. Concave		
	Radius of Curvature Tolerance		14,180m +140m, -1000m	14,030 m	✓
	Astigmatism		< 13nm p-v	2.7 nm	✓
Surface 2	Surface Figure Over Central 200mm dia.		Nominally Flat		✗
	Radius of Curvature of the Wavefront		-9,740m +500m, -100m	-5.02	✓
	Astigmatism		< 15nm p-v	-1.6 nm	✓
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		$\leq 4.3 \text{ cm}^{-1}$ $\sigma_{\text{rms}} < 1.6\text{nm}$	0.8 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 0.18	✓
Surface Errors Surface 2	Low Spatial Frequency Band Central 80mm		$\leq 4.3 \text{ cm}^{-1}$ $\sigma_{\text{rms}} < 1.6\text{nm}$	0.6 nm	✓
	Low Spatial Frequency Band Central 200mm		$\leq 4.3 \text{ cm}^{-1}$ $\sigma_{\text{rms}} < 3.2\text{nm}$	0.8 nm	✓
	High Spatial Frequency Band Central 80 & 200 mm		$\leq 4.3 - 7,500 \text{ cm}^{-1}$ $\sigma_{\text{rms}} < 0.2\text{nm}$	0.19 0.19	✓

5.12
4.82

Scratches, Point Defects & Polish Side 1		Specification	Certification	✓
Scratches	The Total Area of scratches within the central 80mm diameter shall not exceed 25×10^3 square micrometers (width x length).		Hand Sketch w/dimensions	✓
	The total area of scratches outside the central 80 mm diameter shall not exceed 250×10^3 square micrometers. < 5000		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	✓

Small chip on engraved line.

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). < 20,000	Hand Sketch w/dimensions	✓
		The total area of scratches outside the central 80 mm diameter shall not exceed 750×10^3 square micrometers. < 25,000	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**

LIGO Certification Report

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

Serial number: 4ITM02C

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:	4ITM2C1.zip (Side 1)	4ITM2C2.zip (Side 2) 4ITM2C2A.zip (wave front)
TOPO data: (2.5X)	T24IM21A.asc (Side 1)	T24IM22A.asc (Side 2)
	T24IM21B.asc	T24IM22B.asc
	T24IM21C.asc	T24IM22B.asc
(40X)	T44IM21A.asc	T44IM22A.asc
	T44IM21B.asc	T44IM22B.asc
	T44IM21C.asc	T44IM22C.asc

1	Substrate Type:	4ITM
2	Serial Number:	4ITM02C
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.28
8	Team member responsible for measurement/inspection:	C Sona
9	Measurement/inspection results reviewed by:	C Walsh

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	250.97 mm
Cylindricity	0.01 mm
Thickness (maximum - for FM, RM, ETM) (minimum - for BS)	100.008 mm (NB: 0.008 mm above top tolerance)
Bevel as per drawing (height, angle):	(S1) Height: 2.20 mm Angle: $45^{\circ}10'$ (S2) Height: 2.20 mm Angle: $45^{\circ}51'$
Wedge angle:	$1^{\circ}12'$
Location of registration mark (\pm angle with respect to minimum part thickness):	-29"
Location of other 3 marks (with respect to registration mark at minimum thickness)	$89^{\circ}59'$, $179^{\circ}59'$, $269^{\circ}54'$
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:



Chris Walsh

Date:

10 Dec 98

LIGO Certification Report Side and Bevel Polish

1	Substrate Type:	4ITM
2	Serial Number:	4ITM02C
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"*).

There is a small chip on one of the 80 mm engraved lines

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
 Date: 

1	Substrate Type:	4ITM
2	Serial Number:	4ITM02C
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

Date:

10 Dec 98

1	Substrate Type:	4ITM
2	Serial Number:	4ITM02C
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	nil	< 5,000
Surface 2	nil	nil	< 20,000	< 25,000

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
10 Dec 98

Chris Walsh

Date:

4ITMO2

Thin
SIDE 1

1000
1000

2000

SLIDE 2

1000

1000

1000

2000

2000

5000

2000
2000

2000

1	Substrate Type:	4ITM
2	Serial Number:	4ITM02C
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, p.45
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	14.03	2.7	4ITM2C1.zip
Surface 2	-30.48	-1.6	4ITM2C2.zip
Wavefront*	-5.02		4ITM2CT.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:

10 December 98

LIGO Certification Report Surface Errors - Low

1	Substrate Type:	4ITM
2	Serial Number:	4ITM02C
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, p 45
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	0.8
Surface 2	0.6	0.8

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
10 December 98

Chris Walsh

Date:

1	Substrate Type:	4ITM
2	Serial Number:	4ITM02C
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 nm

Side 2: 0.19 nm

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

Side 1: 0.18 nm

Side 2: 0.19 nm

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

	A	B	C	D	E	F	G	H
Surface 1	0.17	0.17	0.17	0.18	0.17	0.20	0.20	0.20
Surface 2	0.18	0.19	0.18	0.19	0.19	0.21	0.19	0.17

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:



Chris Walsh

Date:

LADI CERTIFICATION DATA

Title: 4ITM02T

Date: 12/01/98

Diameter: 200 mm

Astig: -32.6 nm

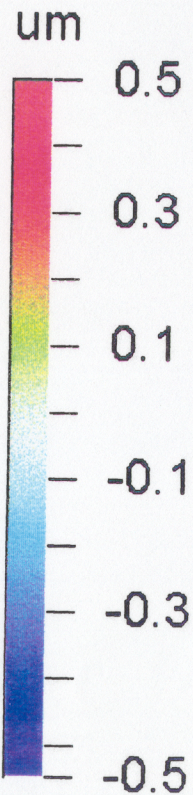
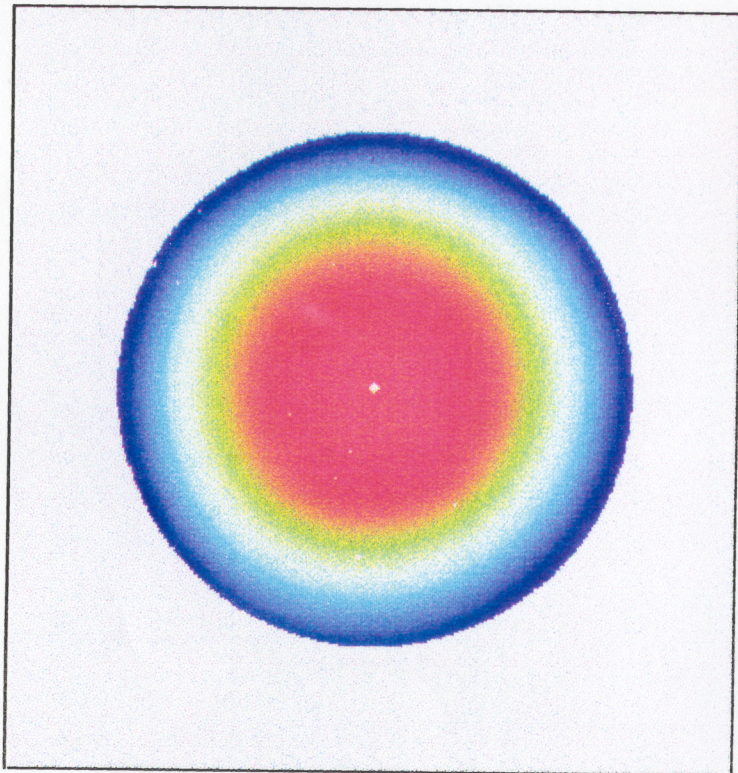
Power: -998.1 nm



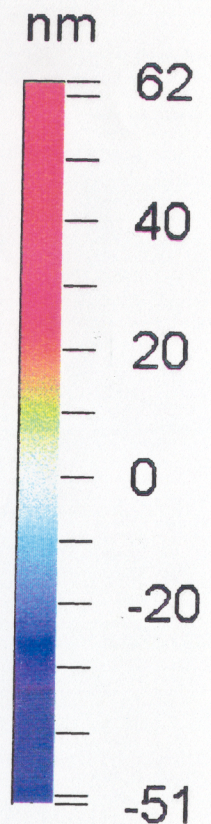
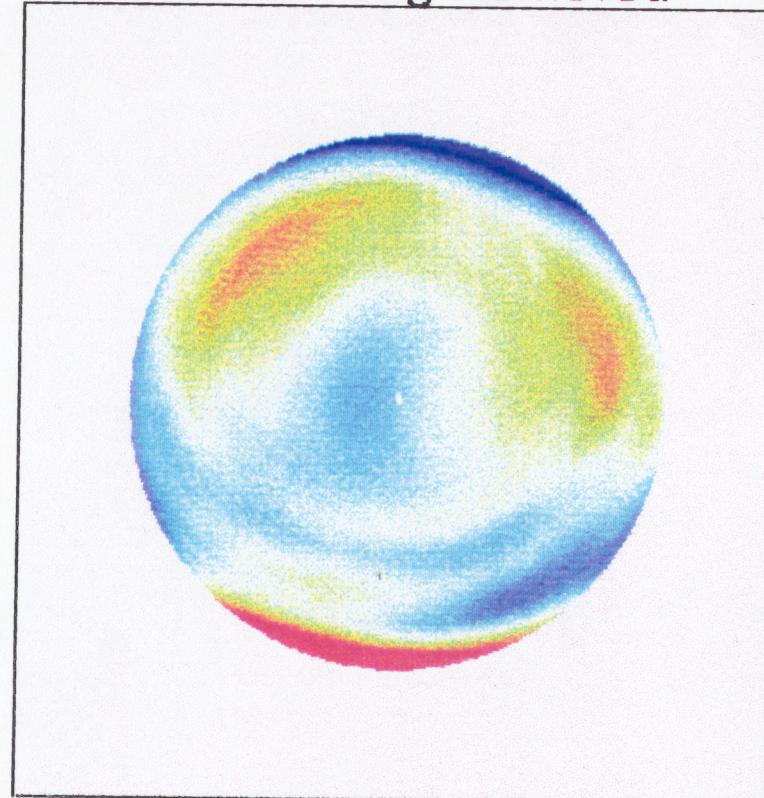
PV: 113.5 nm

RMS: 10.7 nm

Tilt Removed



Tilt/Power/Astig Removed



LADI CERTIFICATION DATA

Title: 4ITM022

Date: 11/18/98

Diameter: 200 mm

Astig: -1.6 nm

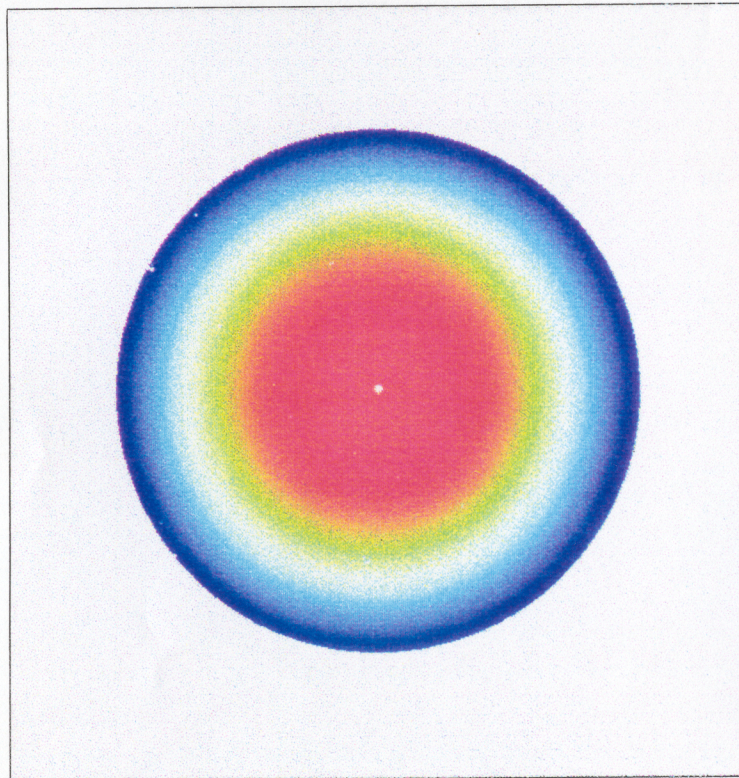
Power: -164.4 nm



PV: 7.9 nm

RMS: 0.8 nm

Tilt Removed



nm

84

50

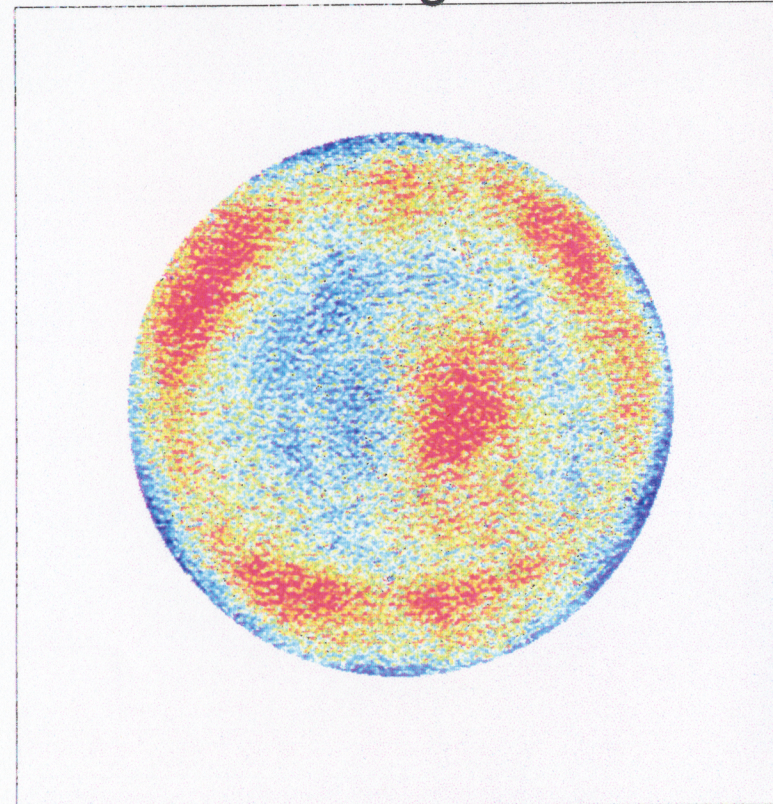
20

-10

-40

-88

Tilt/Power/Astig Removed



nm

4.2

2.5

1.0

-0.5

-2.0

-3.7

LADI CERTIFICATION DATA

Title: 4ITM021

Date: 10/16/98

Diameter: 200 mm

Astig: 2.7 nm

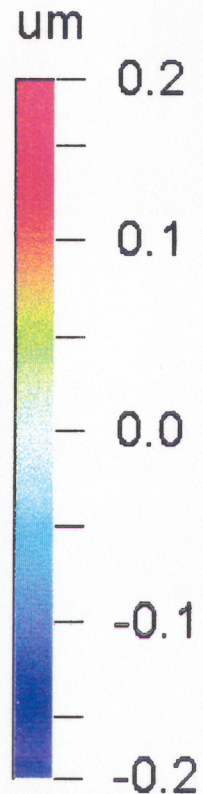
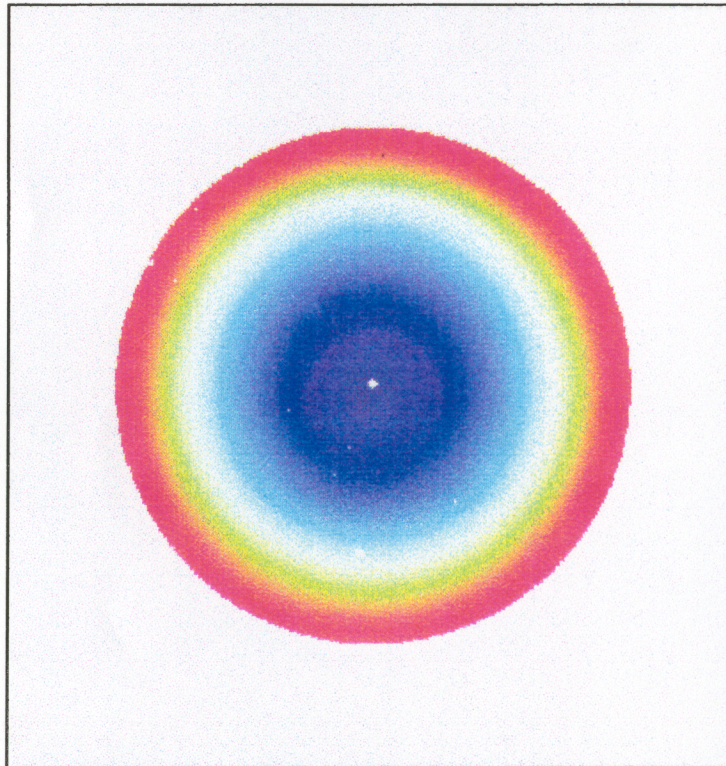
Power: 357.1 nm



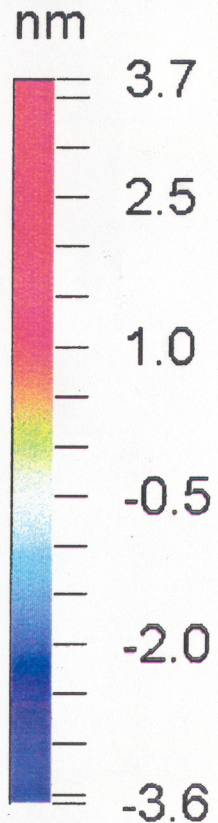
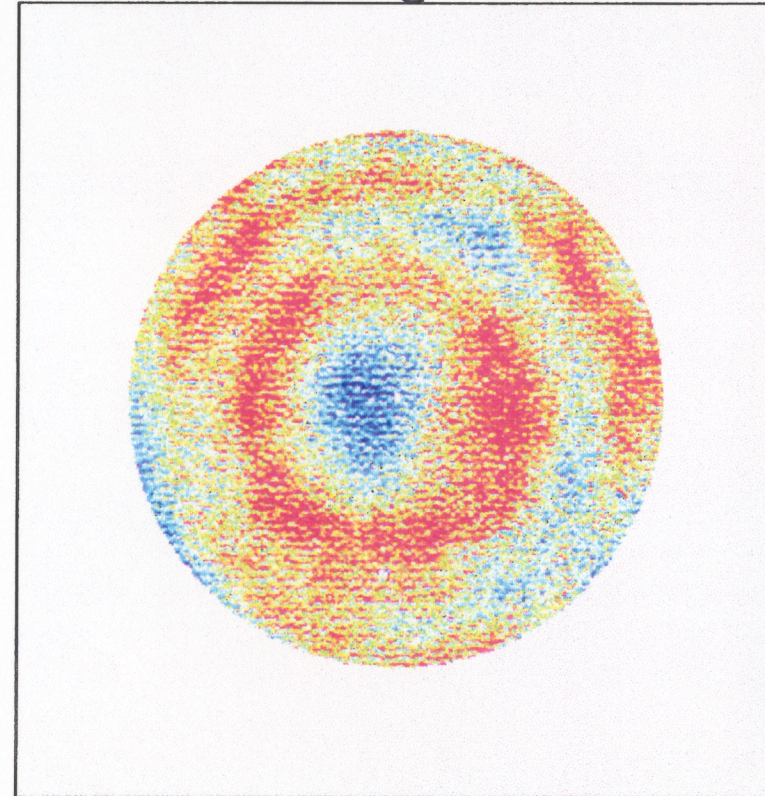
PV: 7.3 nm

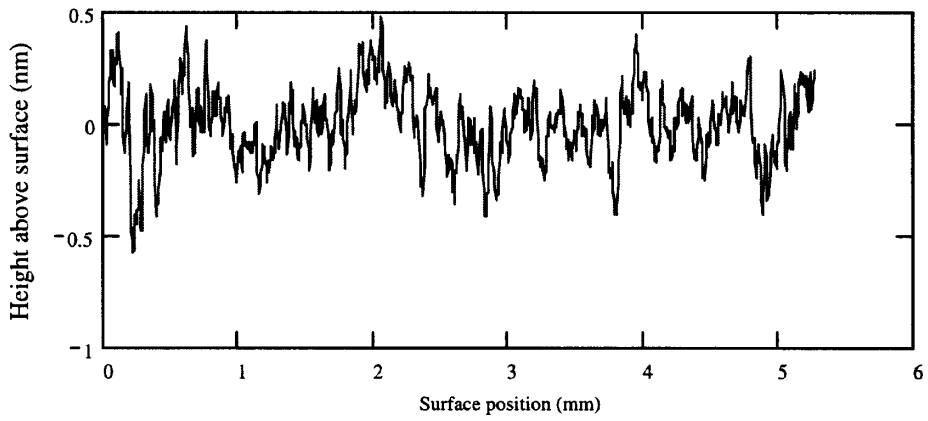
RMS: 0.8 nm

Tilt Removed

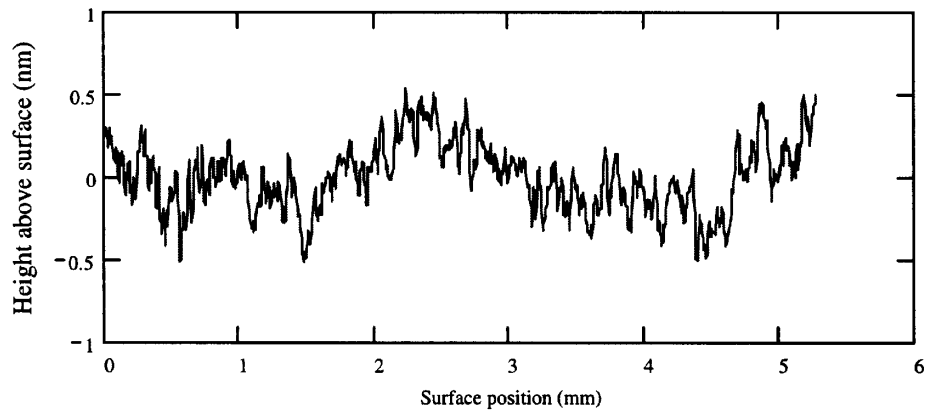


Tilt/Power/Astig Removed

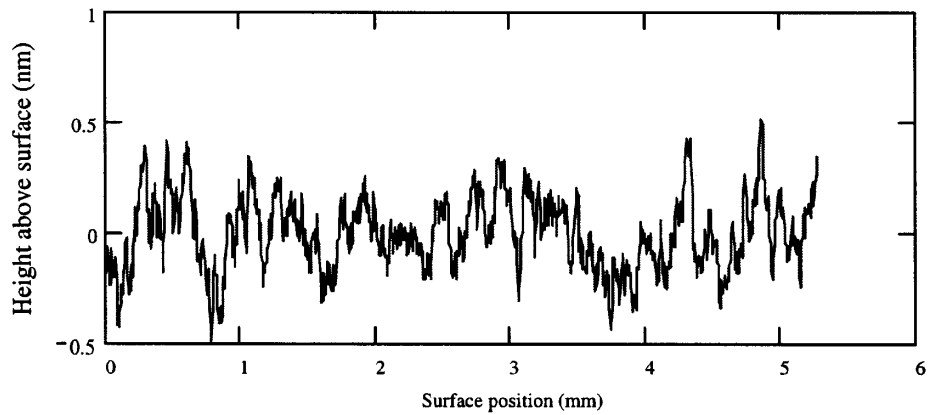




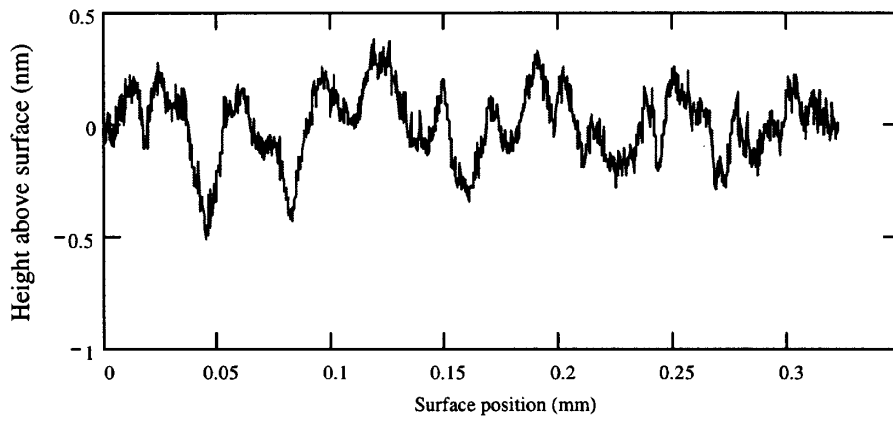
T24IM21A.asc



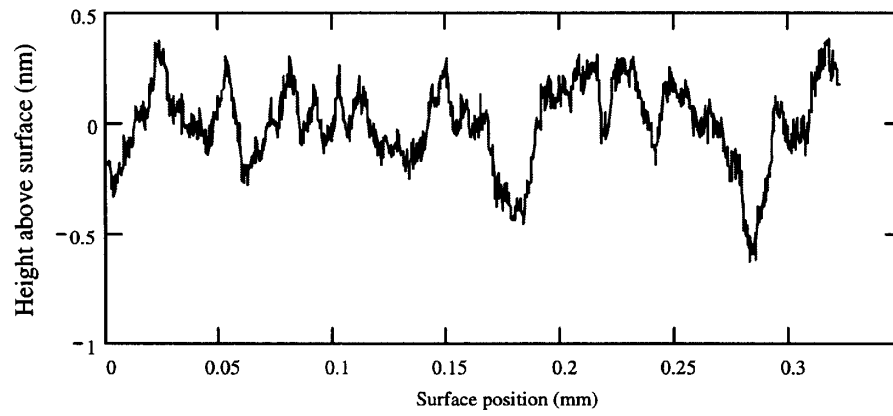
T24IM21B.asc



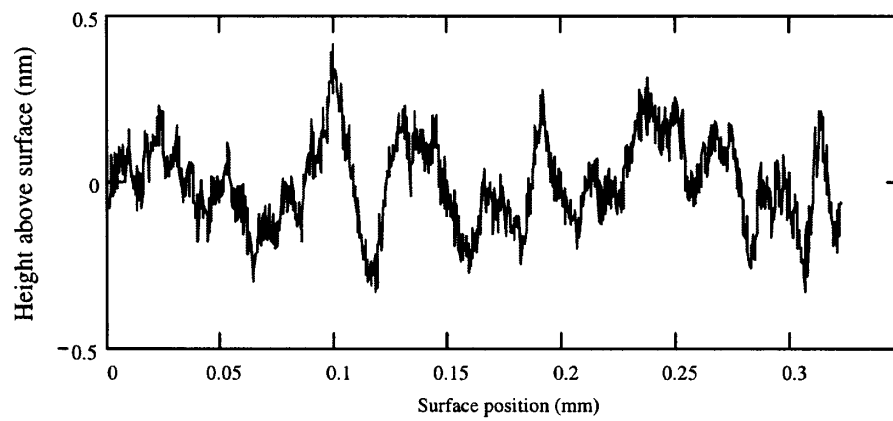
T24IM21C.asc



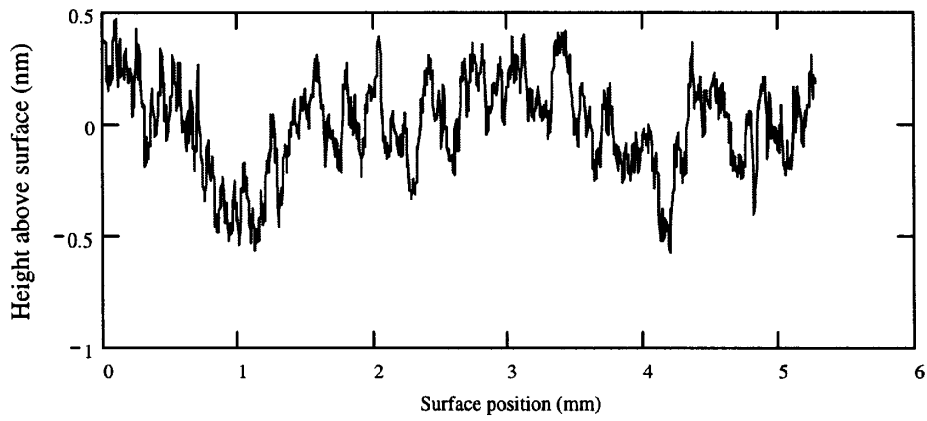
T44IM21A.asc



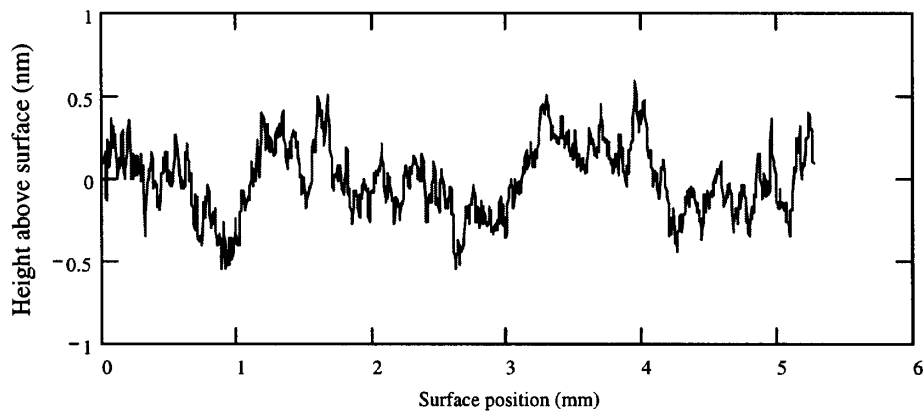
T44IM21B.asc



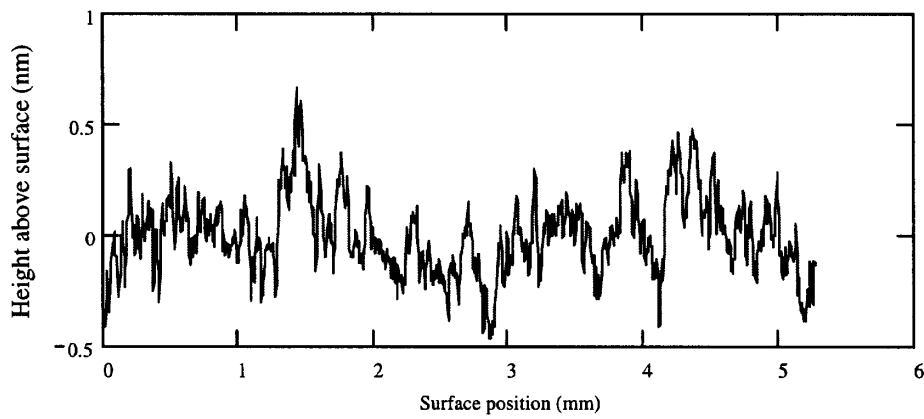
T44IM21C.asc



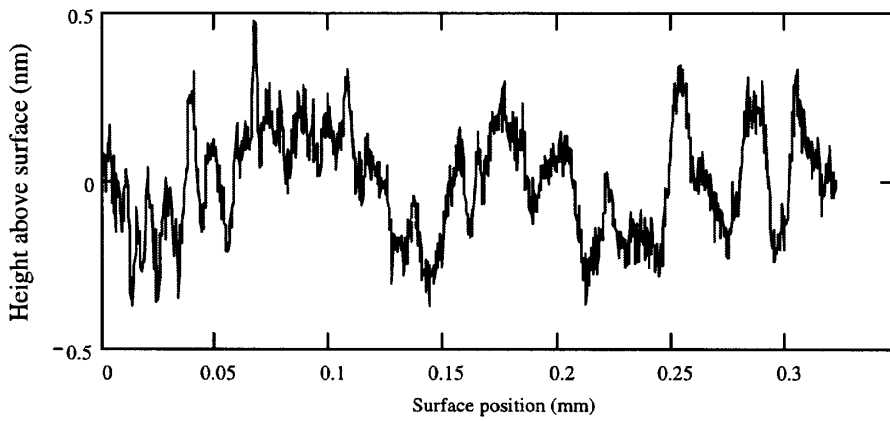
T24IM22A.asc



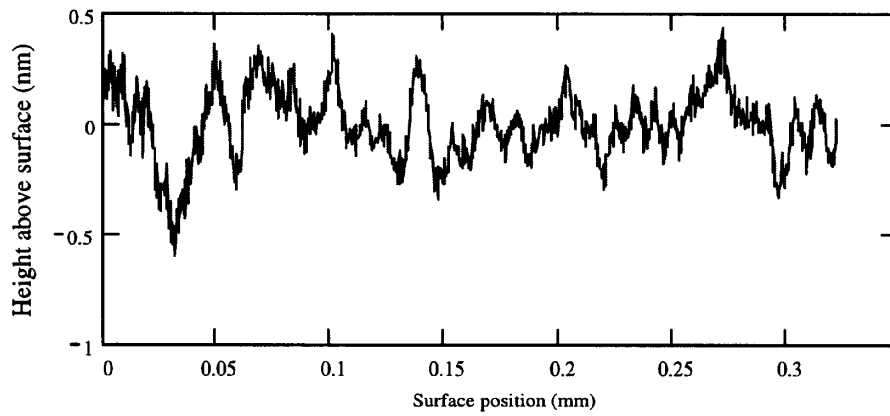
T24IM22B.asc



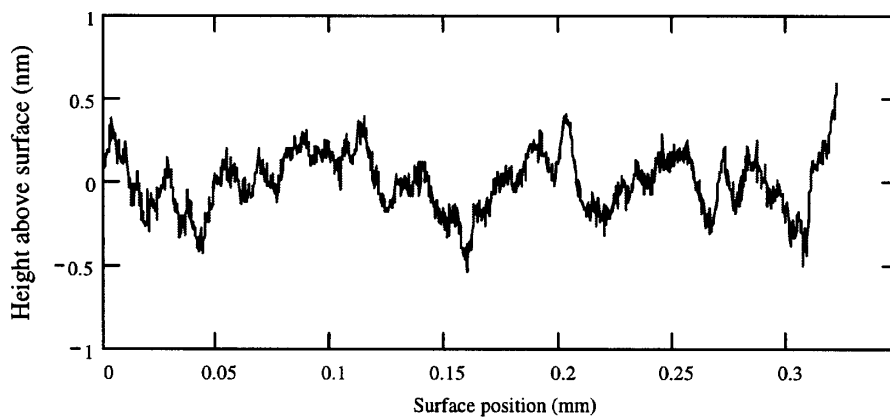
T24IM2C.asc



T44IM22A.asc



T44IM22B.asc



T44IM22C.asc

MIRROR



Research Electro-Optics, Inc.
 1855 South 57th Court
 Boulder, CO 80301-2809
 Phone: 1-303-938-1960 Fax: 1-303-447-3279
 ISO 9001 Registered

ORDER NO. 09000001
 ORDER DATE 06/23/99
 ORDER TIME 10:00 AM
 ORDER NUMBER 00162510, 000000

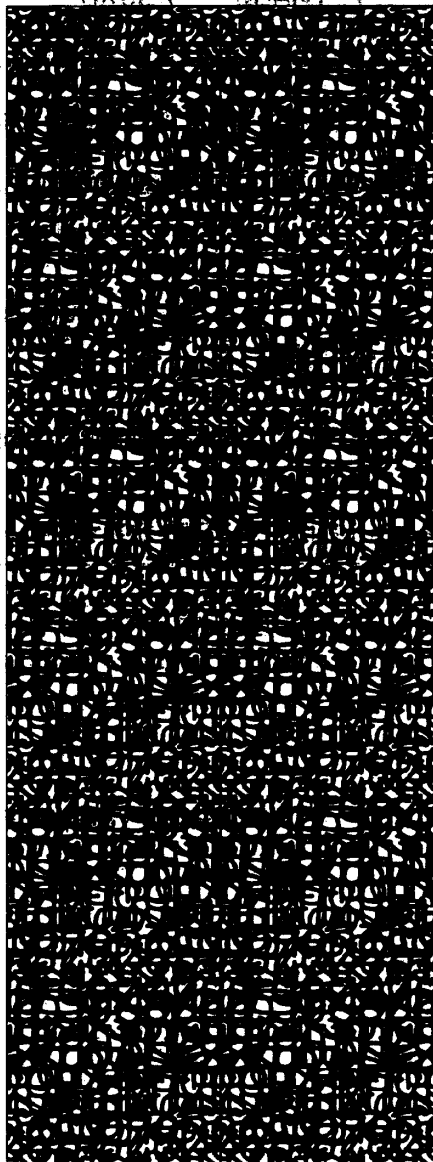
P A R T N O R M A L

TO: [Faded]
 FROM: [Faded]
 [Faded]
 [Faded]

RE: [Faded]
 [Faded]
 [Faded]
 [Faded]

QUANTITY: 4
 PRICE: \$150.00
 TOTAL: \$600.00
 TERMS: NET 30
 NET DATE: 07/23/99
 CREDIT: 100%
 LPS: [Faded]

LN#	ITEM/CATALOG	ITEM	UM	ORDER	QUANTITY	SHIPPED	BACKORDER
				QTY		QTY	



3

4ITMØ2
4ITMØ3

Rec'd 6-24-99
[Signature]

DATE: [Faded] CHECKED BY: [Faded] DATE: [Faded]

No certs