

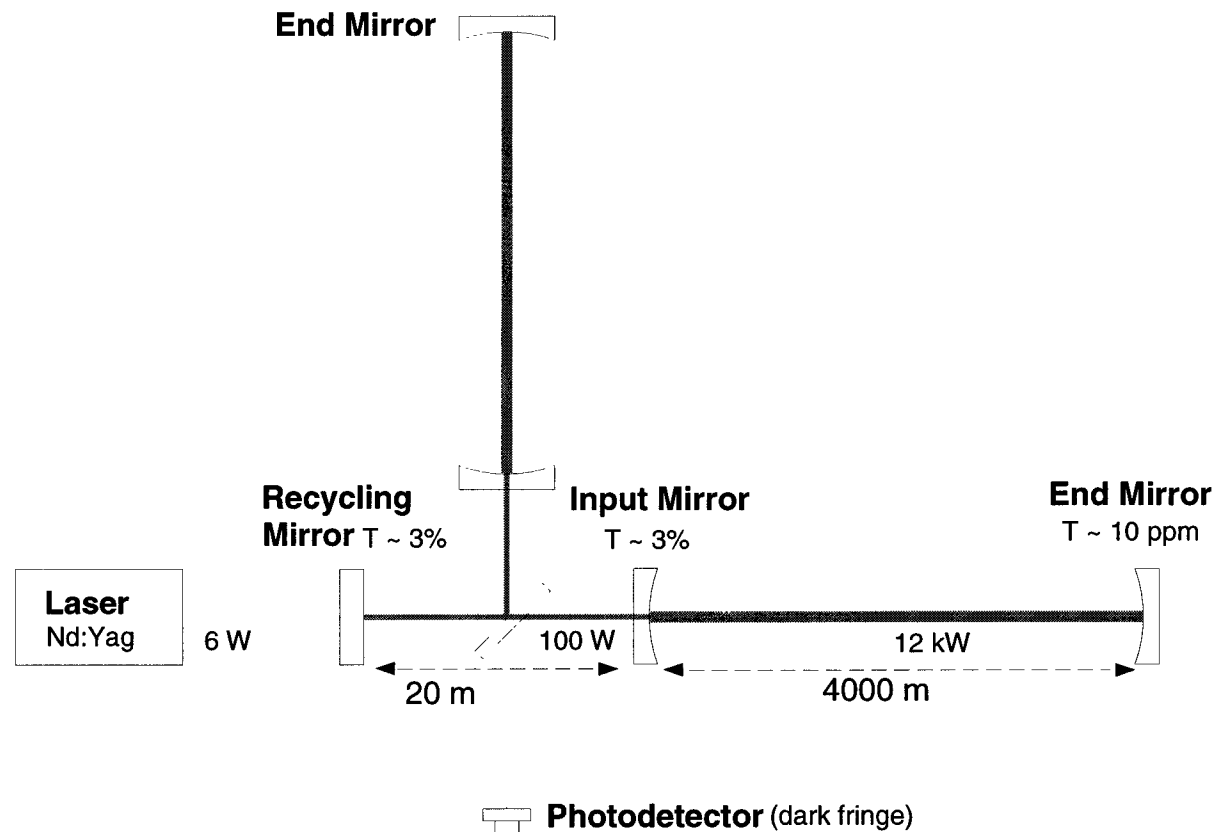
LIGO Core Optics Procurement

- Core Optics overview
- Pathfinder
- Procurement Process
- Summary



Large Optical Components ("Core Optics")

- Test Masses
 - ›› End Mirror
 - ›› Input Mirror
- Beamsplitter
- Recycling Mirror
- Total Number: 20
 - ›› WA 4km: 6 Optics
 - ›› WA 2km: 8 Optics
 - ›› LA 4km: 6 Optics
- + Spares



Core Optics Program Overview

- Glass \$1,915 K
- Polishing \$2,401 K
- Coating \$266 K

Total 4,582 K



Pathfinder - Technology Demonstration



OBJECTIVES

- Polish and measure well past state of the art levels
- Determine feasibility of LIGO goals on a production scale
- Feed back “actual” data into the LIGO computer model
- Refine the LIGO specifications
- Identify potential vendors for LIGO fabrication



Pathfinder Polishing Vendors

SUPERPOLISHERS - low level metrology

General Optics

Research Electro Optics

one substrate
each

NIST
Metrology

HIGH TECH POLISHERS - full metrology

Carl Zeiss

CSIRO

Eastman Kodak

Hughes Danbury Optical Systems

Photon Sciences International

REOSC Groupe sfim

Zygo Corporation

CSIRO

HDOS

two substrates each



Pathfinder - CSIRO

Proposed

6 month program

Polish to specification

- Figure: < 31 nm
- Error: < 0.8 nm rms
- microroughness: < 0.4 nm rms

Actual

6 month program

Exceeded specification

- Figure: 4 nm
- Error: 0.6 nm rms
- microroughness: 0.3 nm rms



Pathfinder - HDOS

Proposed

4 month program

Polish to specification

- Figure: < 31 nm
- Error: < 0.8 nm rms
- microroughness: < 0.4 nm rms

Actual

8 month program

Met some specifications

- Figure: 5 nm
- Error: 1.27 nm rms
- microroughness: 0.4 - 0.5 nm rms



Pathfinder - REO

Proposed

3 month program

Polish to specification

- Figure: < 31 nm
- microroughness: < 0.1 nm rms

Actual

13 month program

Out of specification



Pathfinder - GO

Proposed

3 month program

Polish to specification

- Figure: < 31 nm
- microroughness: <0.1 nm rms

Actual

4 month program

Exceeded specification

- Figure: 4 nm
- Error: 0.3 nm rms
- microroughness: 0.08 nm rms

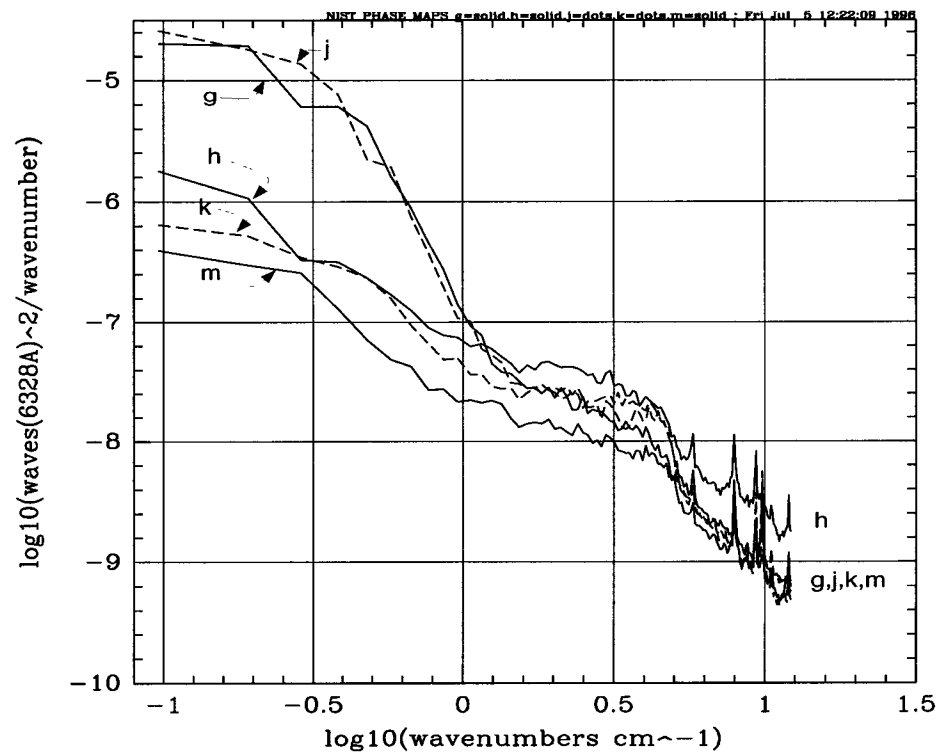


Pathfinder Summary

Independent NIST Evaluation

Surface Quality

1. General Optics (m)
2. CSIRO (h,k)
3. HDOS (g,j)



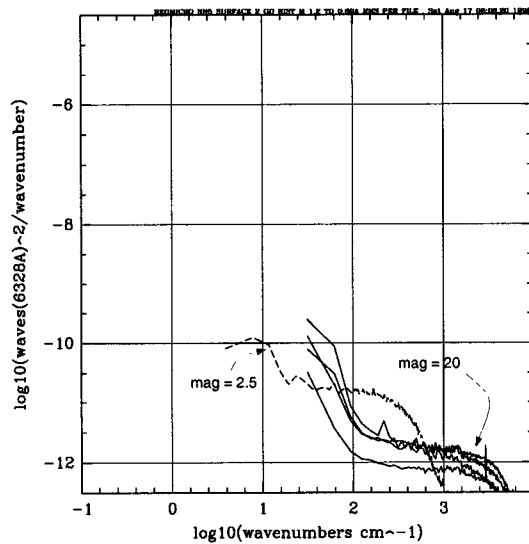
LOWER IS BETTER



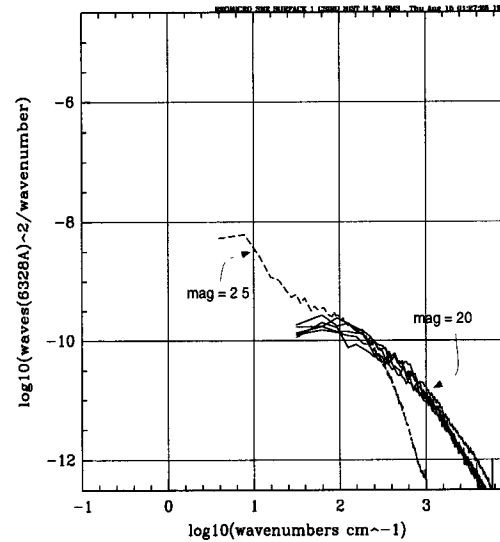
Pathfinder Summary

Independent (REO) measurement of microroughness

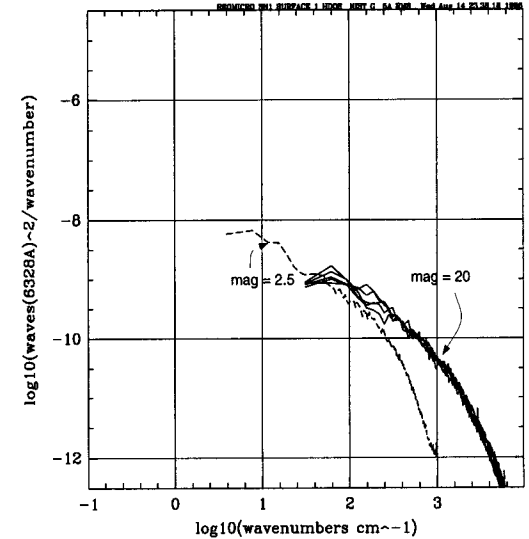
Microroughness Quality (smoothness on a very small scale)



1. GO



2. CSIRO

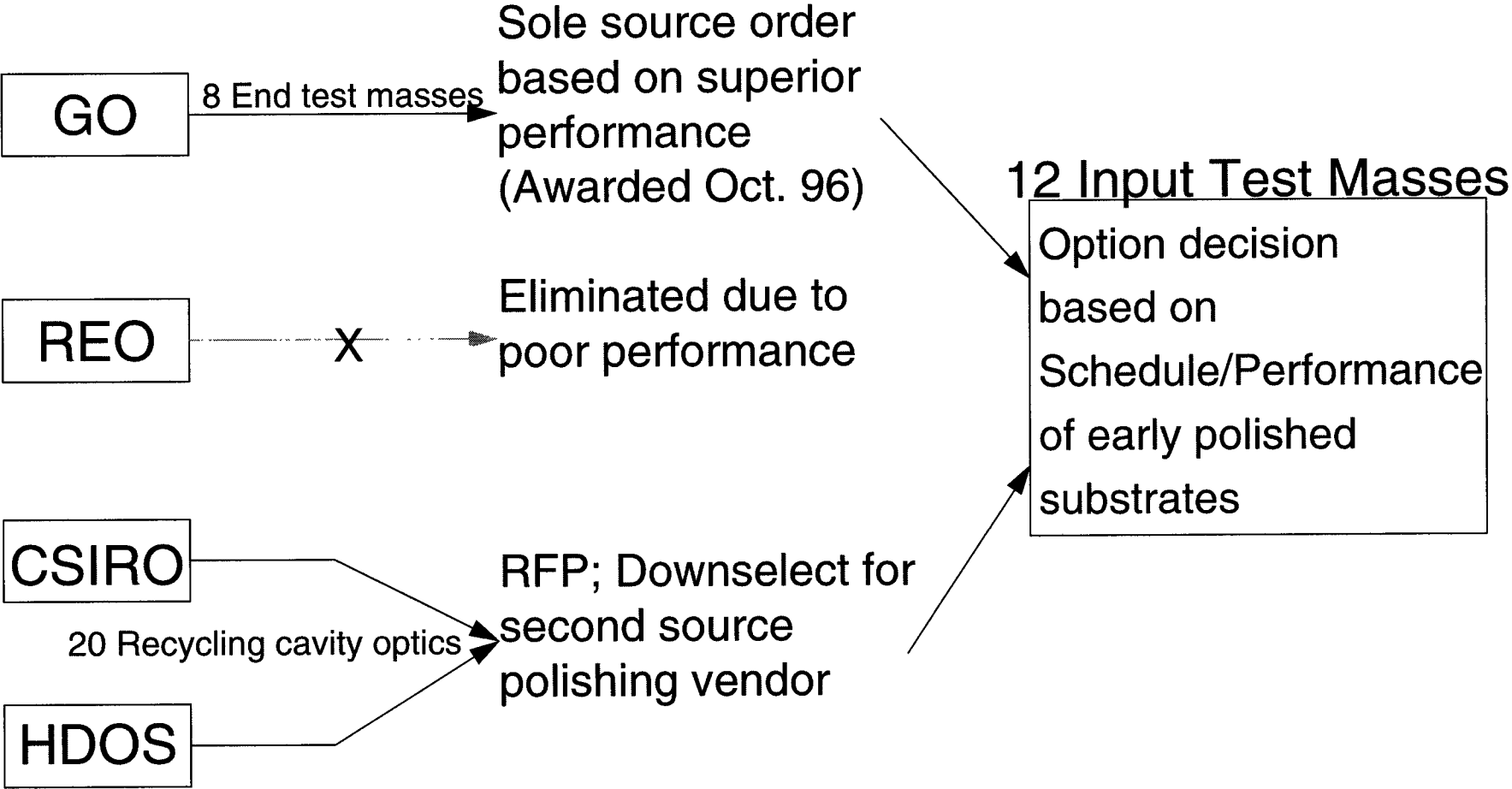


3. HDOS

LOWER IS BETTER



COC Procurement Overview



Procurement Process

- RFP issued to HDOS and CSIRO for a Pathfinder downselect
- Received proposals - Both responsive
- Evaluation Process
 - ›› Evaluation Committee
 - G. Billingsley, Cognizant LIGO Engineer And Evaluation Committee Chair
 - D. Jungwirth, LIGO Optics Engineer
 - W. Kells, LIGO Optics Scientist
 - A. Lazzarini, LIGO System Engineer
 - I. Petrac, LIGO Subcontracts Manager
 - D. Shoemaker, LIGO Deputy Detector Group Leader
 - ›› Source Selection Board
 - G. Sanders, LIGO Project manager, Source Selection Official
 - K. Dombrowski, Procurement Manager
 - S. Whitcomb, Detector Group Leader
- Selection Decision



Evaluation Results

	Maximum Score	CSIRO Assigned Score	HDOS Assigned Score
Cost: The degree to which proposed cost for the polishing services overall as well as on the Substrate unit basis are competitive and realistic. Firm-fixed-price offers for polishing will be preferred	35	32	13
Technical Capability: The degree to which the proposer's performance on the "Optics Polishing Technology Demonstration" or other similar programs, demonstrates technical capability for successful completion of the polishing effort.	25	21	19
Metrology Capability: The degree to which the proposer demonstrates capability to measure or obtain measurements of specified parameters with sufficient accuracy to meet the requirements of LIGO specifications.	15	11	14
Schedule: The degree to which the proposed production schedule and availability of support resources for polishing of the LIGO substrates is consistent with or exceeds, the RFP schedule. Realistic, accelerated scheduling is preferred.	15	10	13
Quality Control: The degree to which the proposer's Quality Control Plan assures repeatable quality of polishing and consistency, with respect to conformance with the LIGO specifications.	10	8	9
TOTAL	100	82	68



Price Comparison

	CSIRO (\$US)	HDOS (\$US)	Delta (\$US)
Non-recurring Costs	\$155,992	\$227,460	\$71,468
Non-recurring Options	91,922	N/A	(91,922)
Unit Prices			
Folding Mirrors	23,487	58,971	35,484
End Test Masses	28,355	64,067	35,712
Recycling Mirrors	21,230	55,460	34,230
Beam Splitters	28,147	62,853	34,706
Input Test Masses	30,404	69,405	39,001
Total Price	\$804,230	\$1,769,134	\$964,904



Budget vs. Anticipated Cost

CSIRO + GO contracts	\$750 K
Input Test masses	\$100 K - \$365 K
20% Allowance for repolishing	<u>\$211 K</u>
Total	\$1,061 K - \$1,326 K
LIGO Polishing Budget	\$2,401



Customs Duties

- If U.S. Customs applies duties it is anticipated the rate would be 5.3% of the value added to the original product



Linda Stohr Customhouse Broker

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12/13/96

Attn: Irena Petrac
CA INSTITUTE OF TECHNOLOGY
1201 E CALIFORNIA BLVD
PASADENA, CA 91125

Dear Irena,

Per our conversations over the last weeks regarding your upcoming shipments to Australia for the Ligo Project, I can give you the following information. We are still researching the fine points with U.S. Customs and hopefully can confirm exactly what your costs will be early next week.

The optical flats produced here in the U.S. will be shipped to Australia for polishing. When the flats come back they will be treated as U.S. goods returned. The import duties involved in their return are what we are currently researching.

- a) U.S. goods returned after having been exported, without having been advanced in value or improved in condition by any process of manufacture or other means while abroad fall under tariff schedule 9801.00.1010/free of duty.
- b) Articles returned to the U.S. after having been exported to be advanced in value or improved in condition by any process of manufacture or other means fall under tariff schedule 9802.00.50. In this case the duty paid will be upon the value of the repairs or alterations to the original product. The value of the original glass optical panel will not be dutiable. The duty rate is also being researched but may be at the rate of 5.3% of the improved value (including labor costs).

I'm sorry we cannot be specific today, but we are in need of the advice of the import specialist's team leader who will be in on Monday. Thank you for your patience.

Sincerely yours,


Linda Stohr

Summary

- Strategy: Polish/Coat early to allow for rework rather than invest in large numbers of spares
- This Core Optics Polishing Procurement is on the Critical Path for LIGO
- Polishing to start early January to maintain schedule

Recommendation: Approve award of contract to CSIRO

