AD-A255 798

September 12, 1992

Full Surface Testing of Grazing Incidence Mirrors

Principal Investigator: John L. Remo Ph.D.
E.R.G. Systems Inc.
St. James, New York 11780
(516) 584-5540

Eigth and Final Quarter Report: Introductory Outline

FULL-SURFACE INTERFEROMETRIC SCANNER

In the present report, we present the work done during the period of August 12 to September, 1992.

The work includes the implementation of the final testing program for the FSIS prototype system using the latest software package. It also included work on the final report.

The custom T.W.O. cylindrical mirror was used for testing. The scan is made of 5 subapertures, two inches each with one inch overlap area between subapertures.

The project goals for the eight quarters (entire contract) have been achieved. These include:

1. Prototype design,
2. Procurement and testing of components,
3. Mathematics and algorithm development,
4. Interferograms and data reduction algorithms,
5. Construction of first prototype,
6. Automated operation software development,
7. Construction and evaluation of modified prototype,
8. Integration of automated hardware controls and software,
9. Testing full surface interferometer/ aspheric optical surfaces,
10. Initiation of user manual and documentation,
11. Additional testing and modification,
12. Software refinement and development,
13. Completion of the users manual and documentation,
14. Report for the eigth and final quarter, and
15. Final project report.

DTIC
ELECTE
SEP 25 1992
S B D

Approved for public release;
Distribution Unlimited

Research is supported by SDIO/IST and managed by ONR
Contract # N00014-90-C-0246

92-25776

92 9 24 004

ND
pgs
421005

The measurement is now fully automated and operates as follows:

- The interferograms of the five subapertures are captured by scanning the mirror with the NEAT long travel stage under computer control

- Next, the interferograms are computed individually and merged into a single surface using first order least square fitting over the overlap areas.

  This yields a series of slope function profiles or traces of the reflected wavefront in the direction of the long side of the mirror

- Finally, the slope profiles are numerically integrated in the same direction.

  This yields a series of profiles or traces of the reflected wavefront in the direction of the long side of the mirror.

The computer outputs include:

1. A 3-D isometric plot representing a stack of the multiple traces of wavefront slope function

2. A 3-D isometric plot representing a stack of the corresponding multiple traces of the wavefront function.

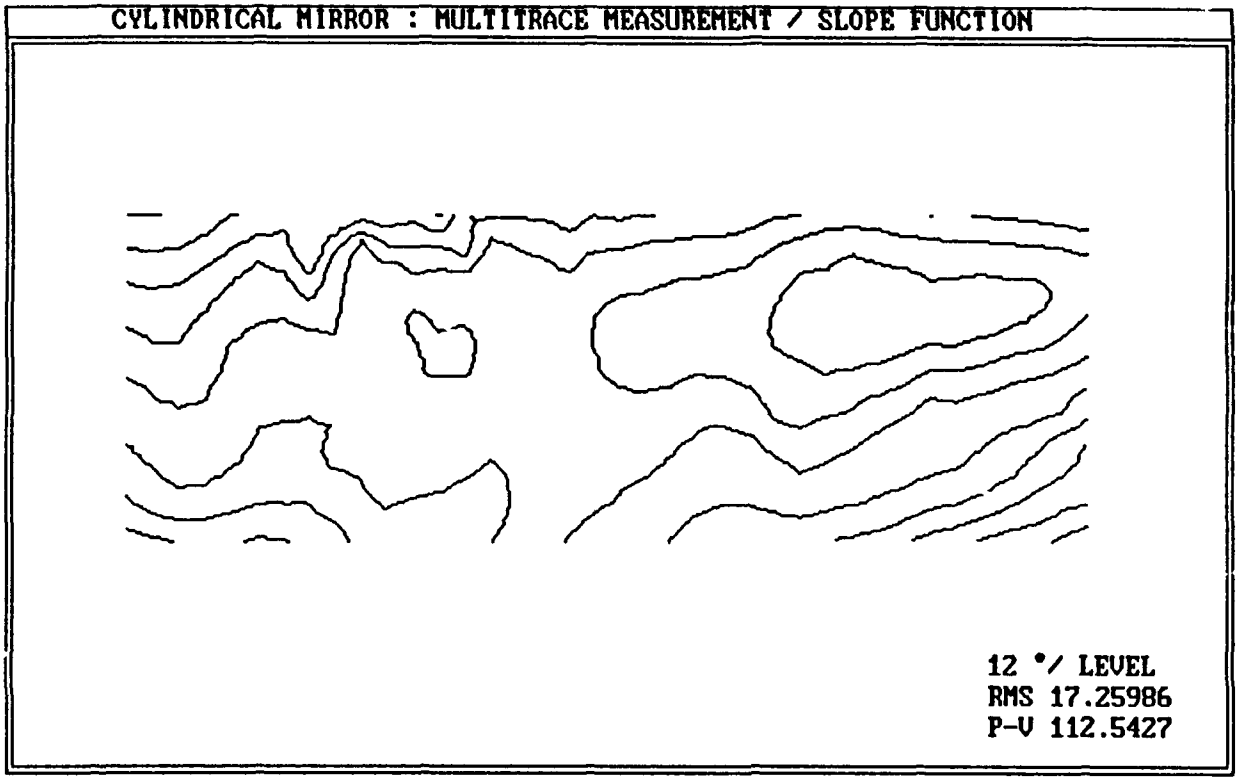
In each case, a single trace of the wavefront slope or the wavefront itself can be extracted and displayed interactively by key in.

Along with the individual trace, the computation yields values for

- The root-mean-square (RMS) deviation

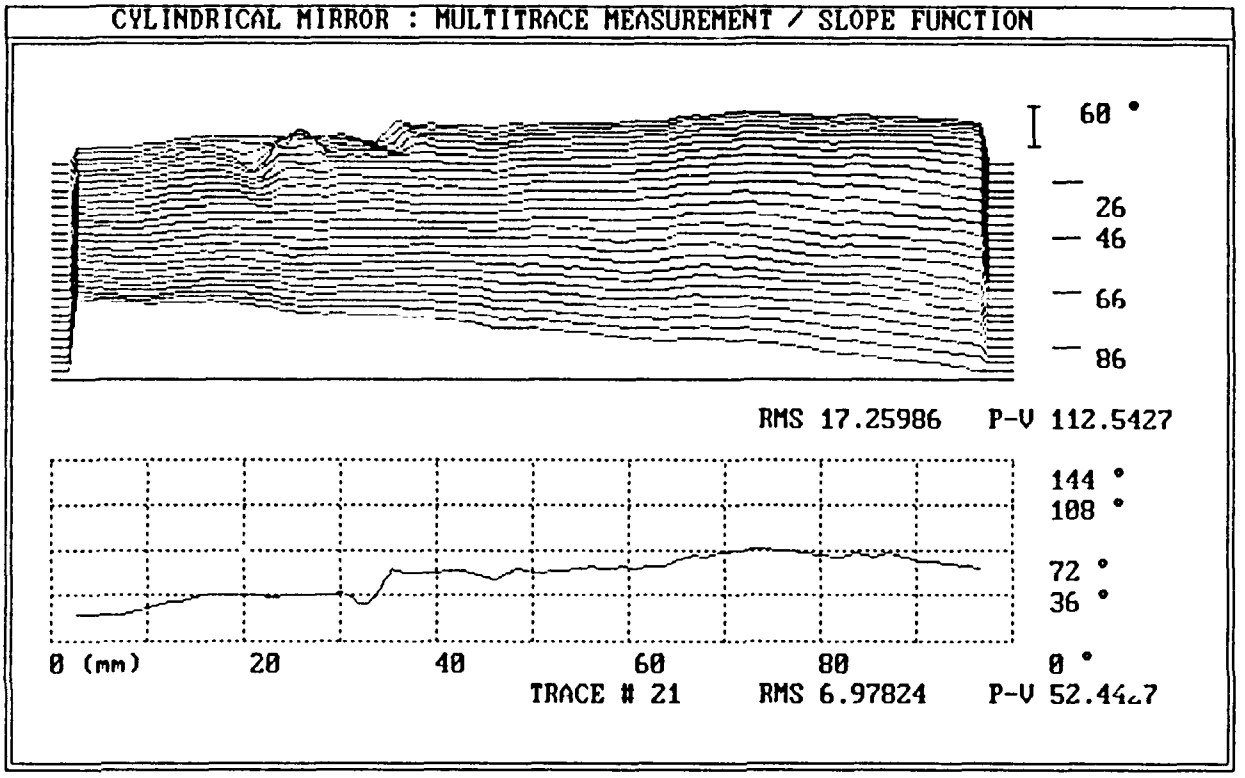
- The peak-to-valley (P-V) deviation.

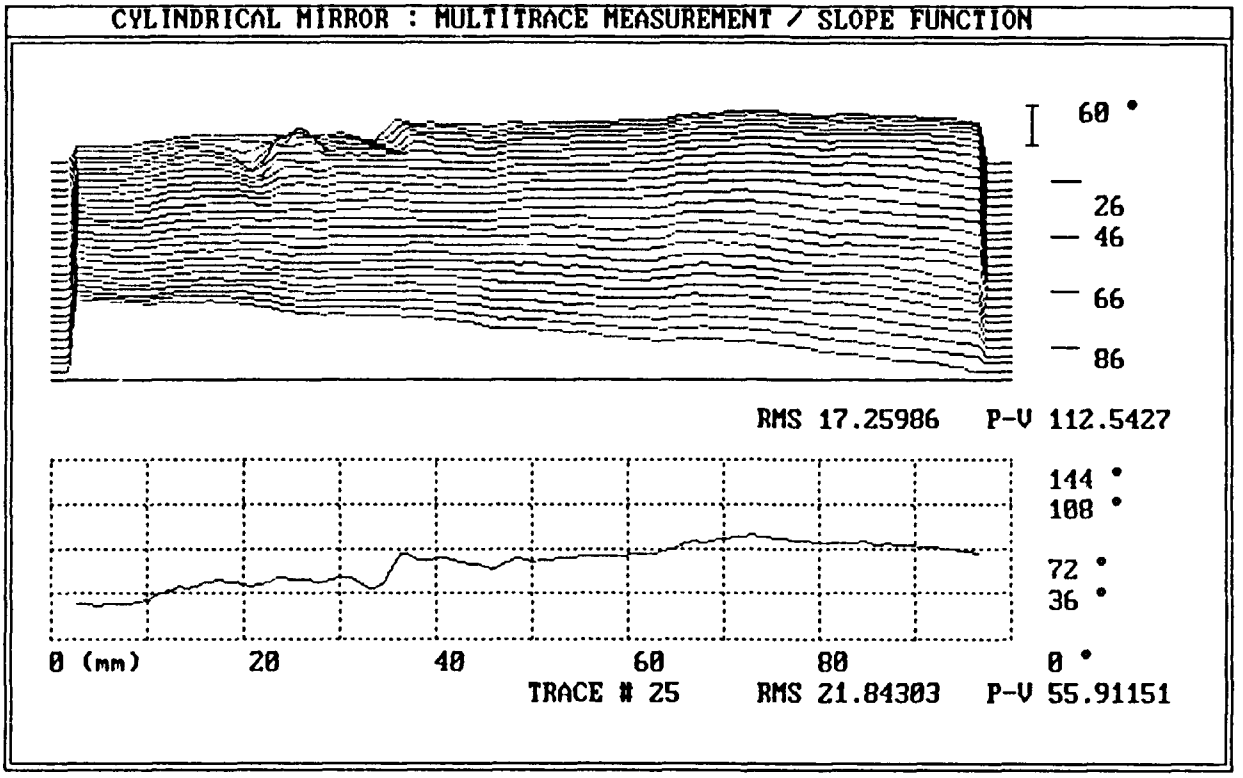
In the following we show the computer plots (36 plots) for the wavefront slope and wavefront corresponding to a typical measurement.

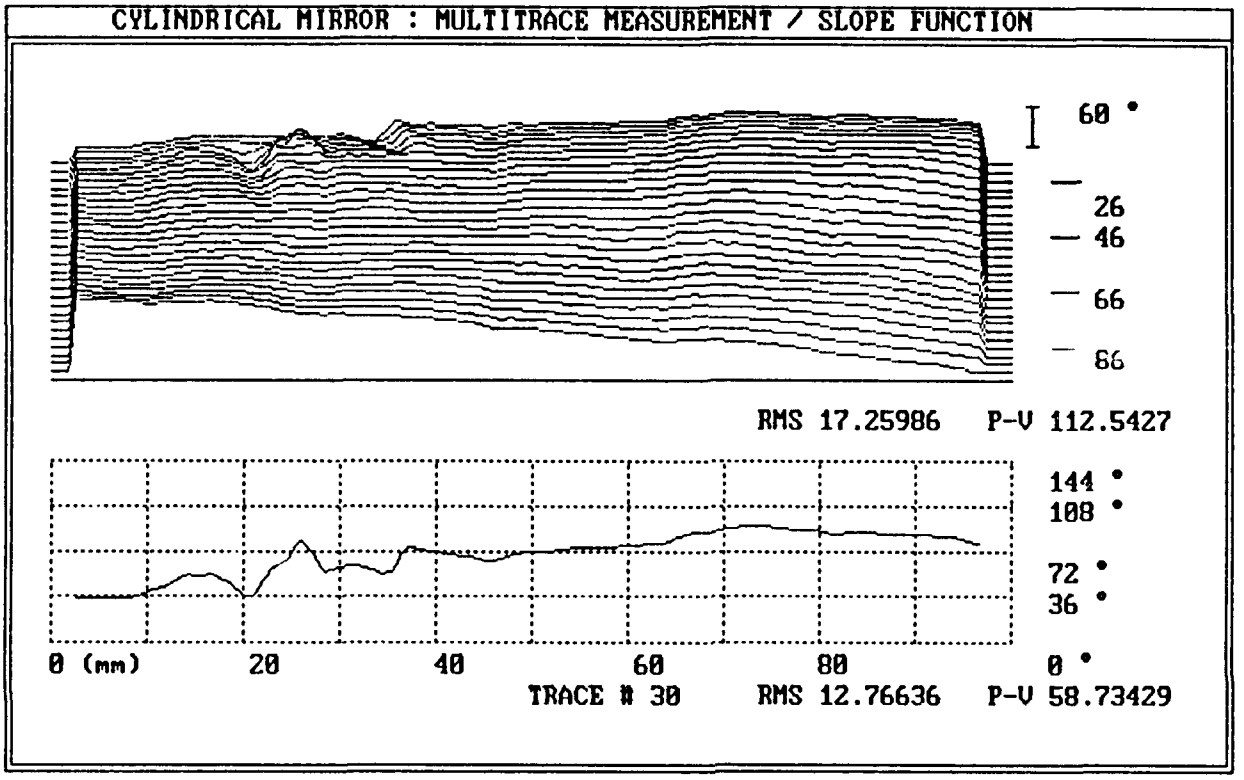


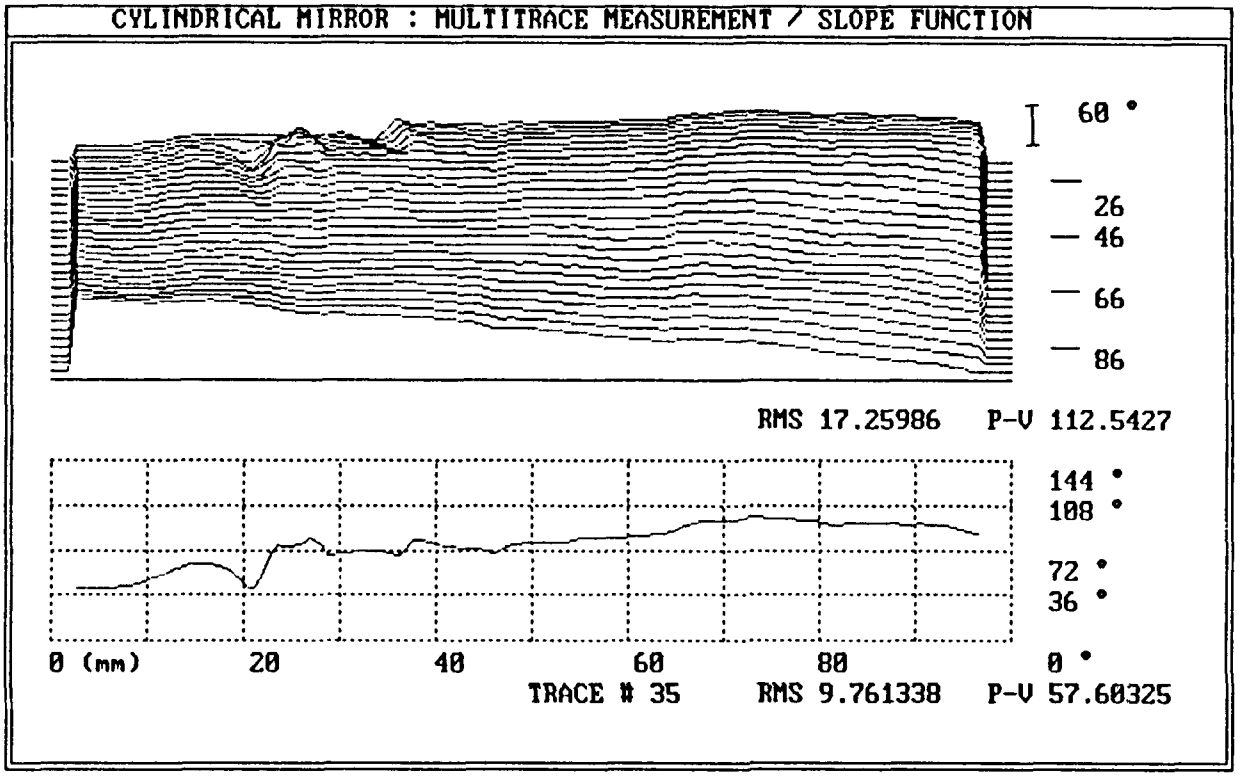
DTIC QUALITY INSPECTED 3

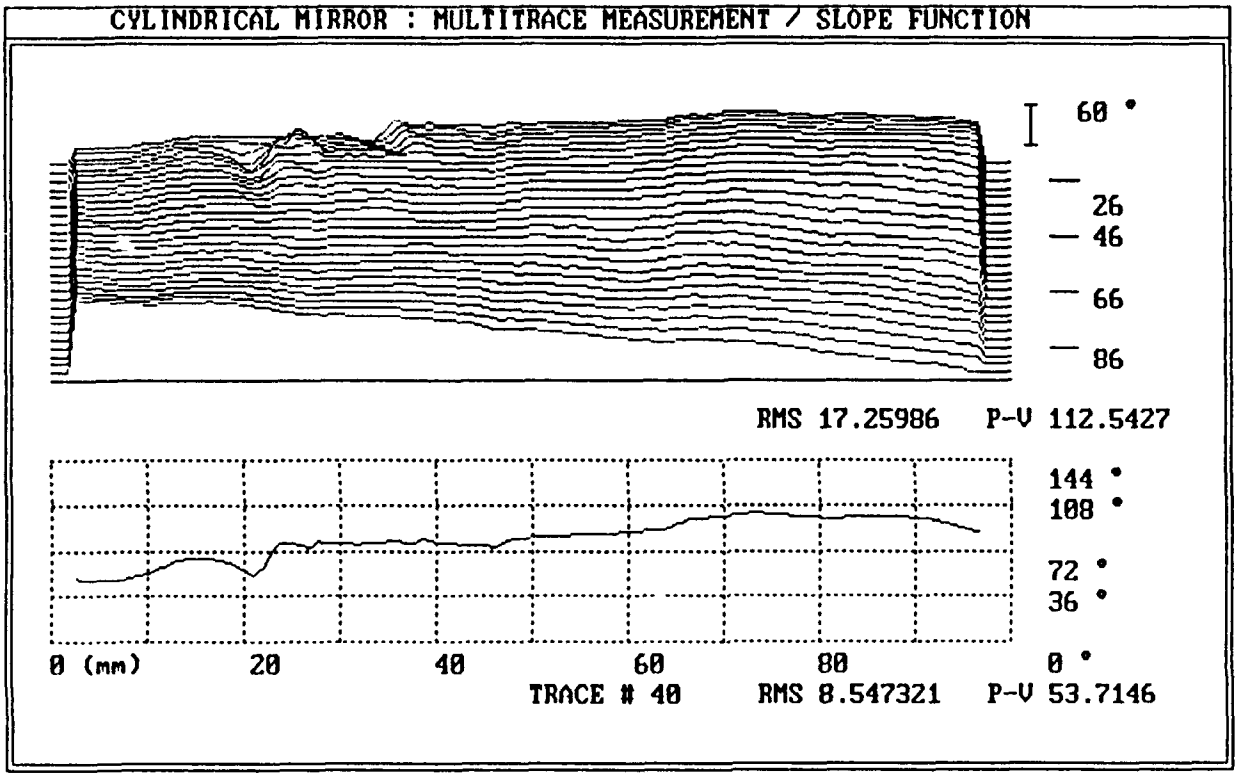
Accession For
NTIS GRA&I ☑
DTIC TAB ☐
Unannounced ☐
Justification
By per ADA252253
Distribution/
Availability Codes
Dist | Avail and/or Special
A-1

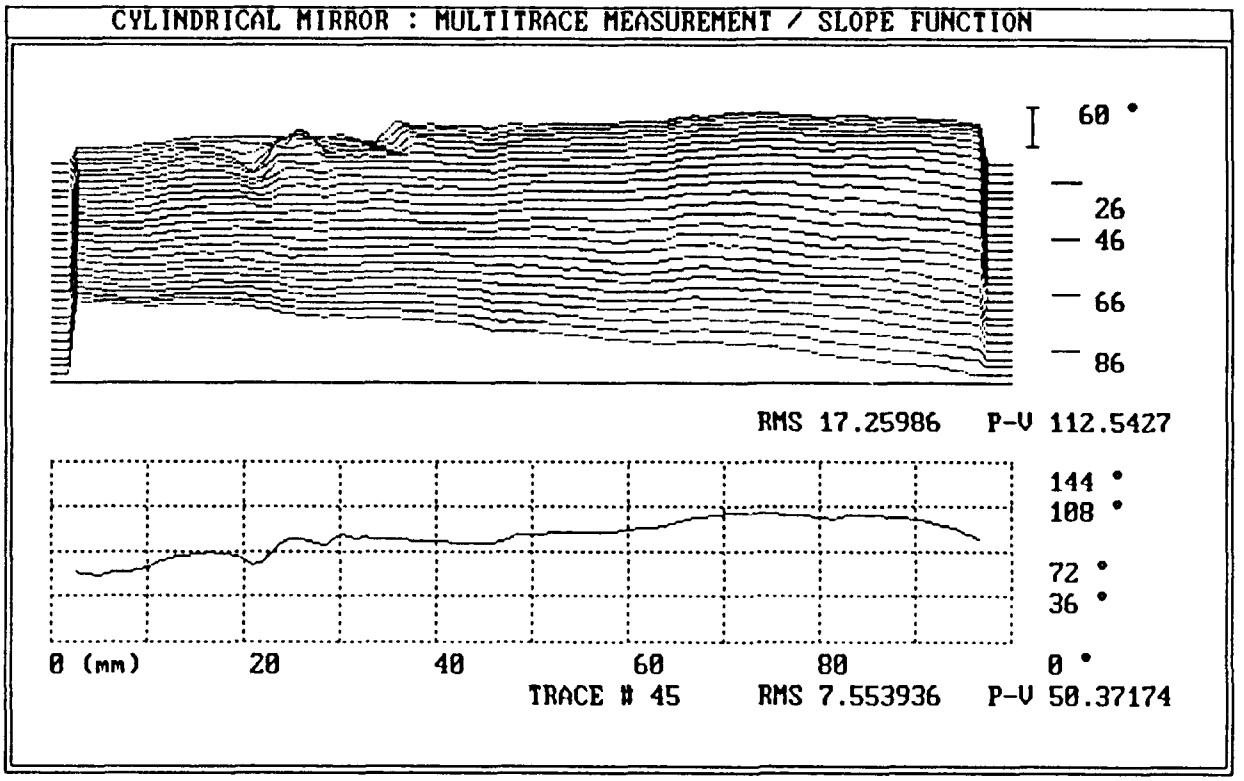

CYLINDRICAL MIRROR : MULTITRACE MEASUREMENT / SLOPE FUNCTION
60 "
26
46
66
86
RMS 17.25986 P-V 112.5427
144 "
108 "
72 "
36 "
0 "
0 (mm)
20
40
60
80
TRACE # 21
RMS 6.97824
P-V 52.44

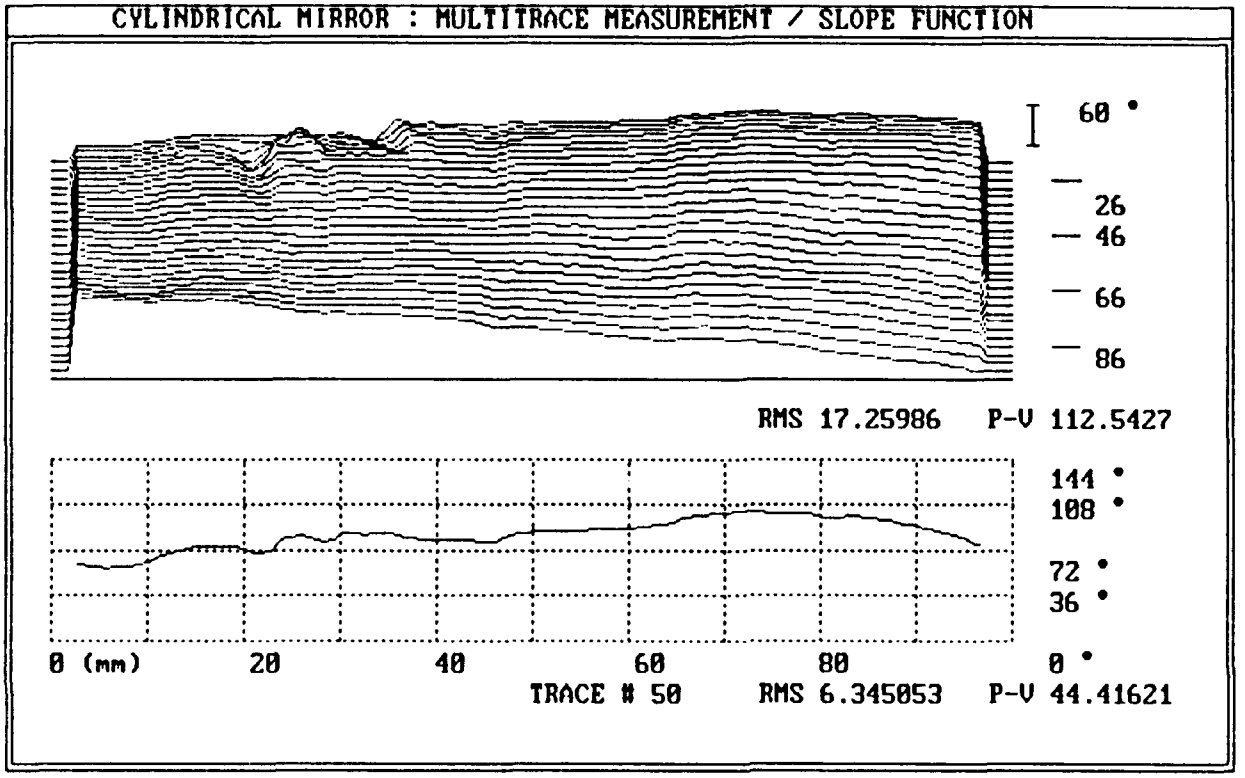

CYLINDRICAL MIRROR : MULTITRACE MEASUREMENT / SLOPE FUNCTION
60
26
46
66
86
RMS 17.25986 P-V 112.5427
144
108
72
36
0
0 (mm)
20
40
60
80
TRACE # 25 RMS 21.84303 P-V 55.91151

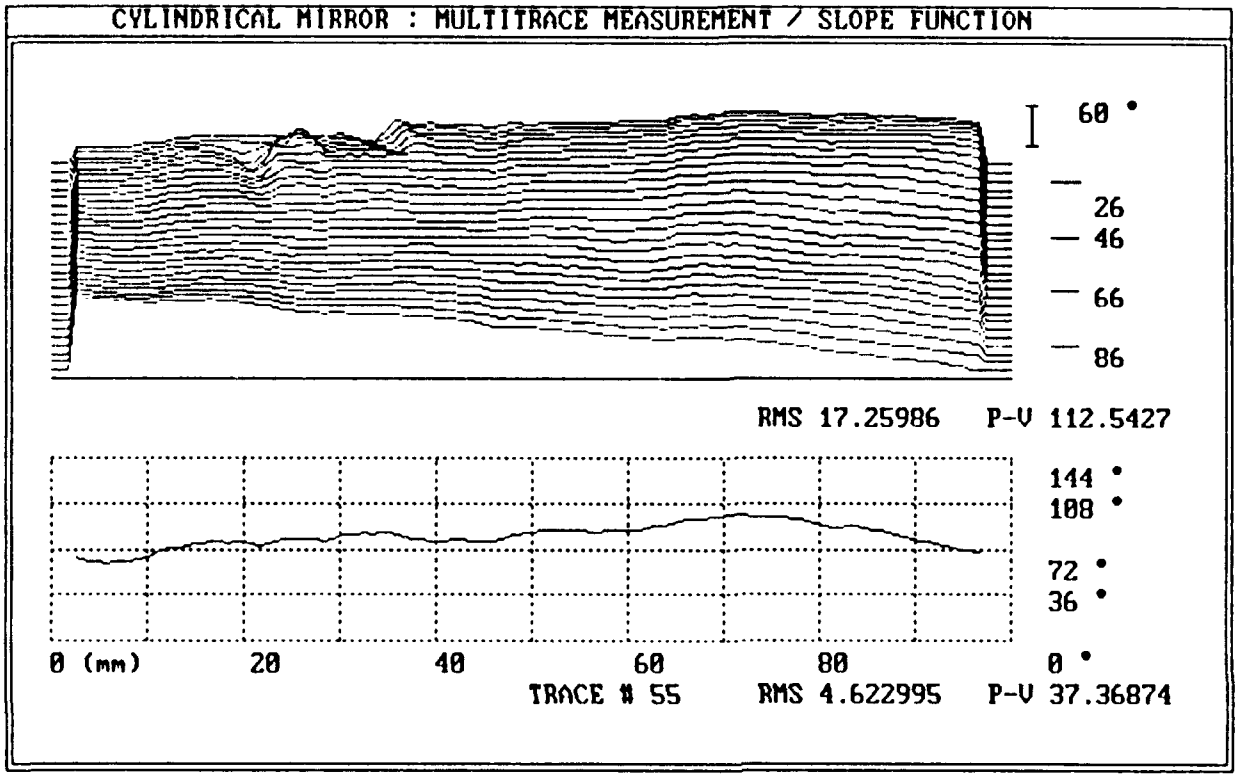

CYLINDRICAL MIRROR : MULTITRACE MEASUREMENT / SLOPE FUNCTION
60
26
46
66
86
RMS 17.25986 P-V 112.5427
144
108
72
36
0
0 (mm)
20
40
60
80
TRACE # 30 RMS 12.76636 P-V 58.73429

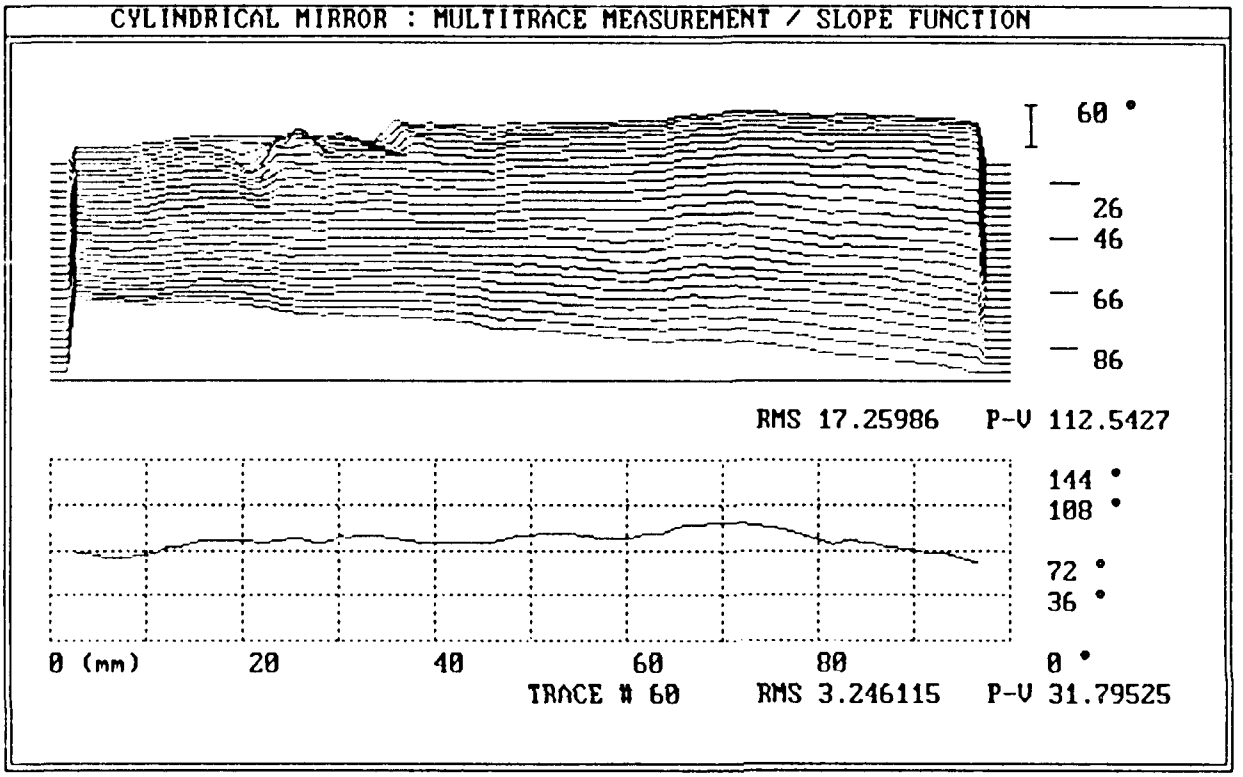

CYLINDRICAL MIRROR : MULTITRACE MEASUREMENT / SLOPE FUNCTION
60 "
26
46
66
86
RMS 17.25986 P-V 112.5427
144 "
108 "
72 "
36 "
0 "
0 (mm)
20
40
60
80
TRACE # 35 RMS 9.761338 P-V 57.60325

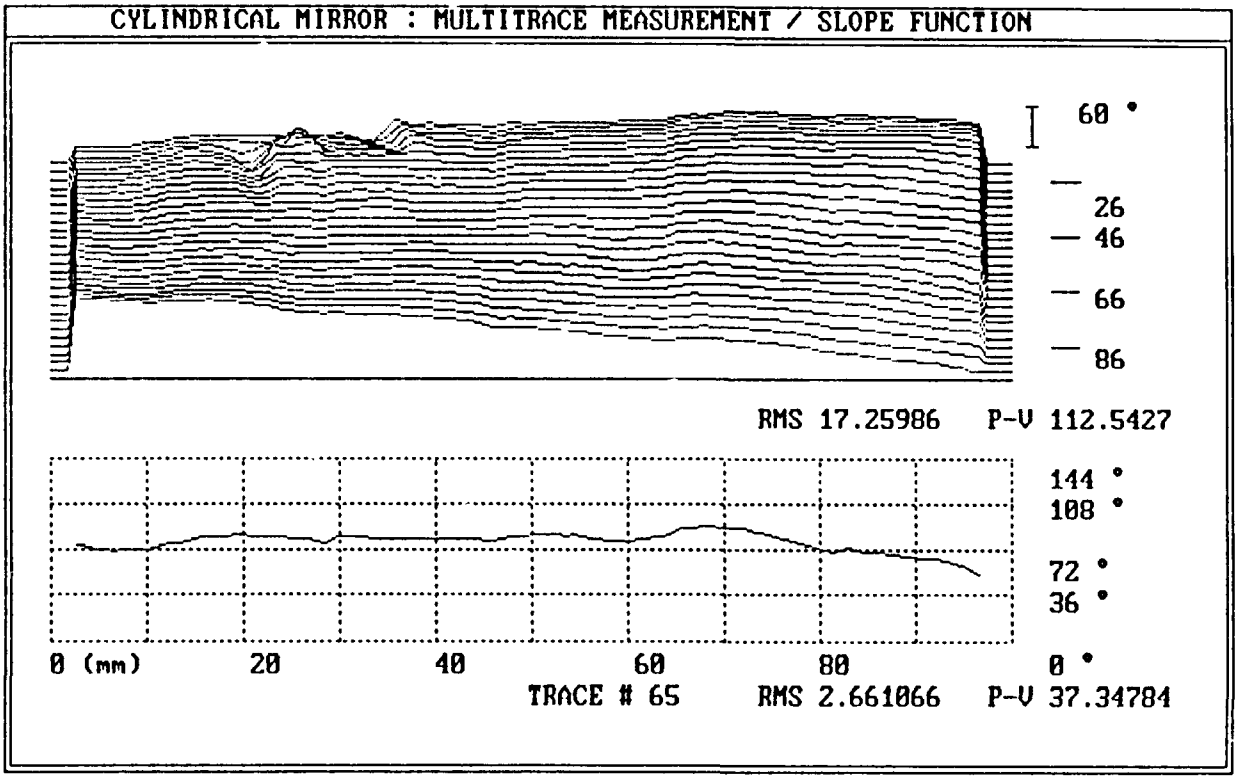

CYLINDRICAL MIRROR : MULTITRACE MEASUREMENT / SLOPE FUNCTION
60 •
26
46
66
86
RMS 17.25986 P-V 112.5427
144 •
108 •
72 •
36 •
0 •
0 (mm)
20
40
60
80
TRACE # 40 RMS 8.547321 P-V 53.7146

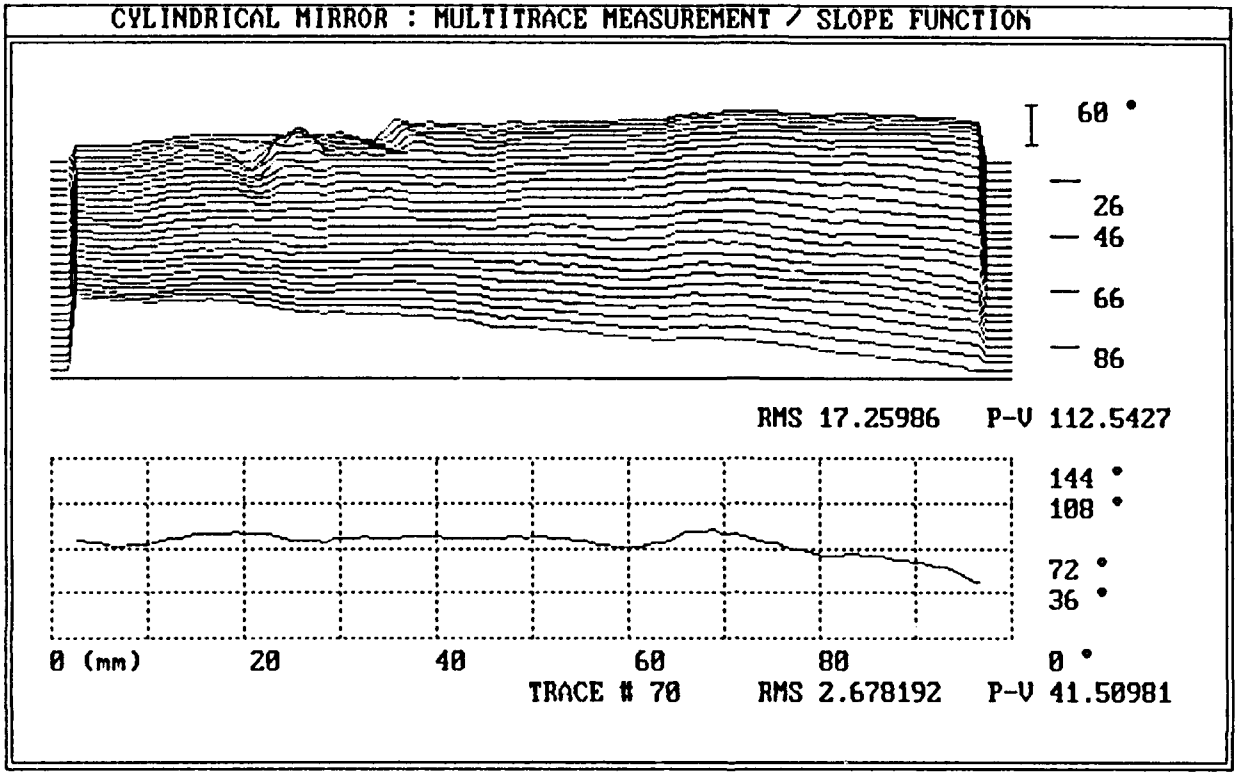

CYLINDRICAL MIRROR : MULTITRACE MEASUREMENT / SLOPE FUNCTION
60
26
46
66
86
RMS 17.25986 P-V 112.5427
144
108
72
36
0
0 (mm)
20
40
60
80
TRACE # 45 RMS 7.553936 P-V 50.37174

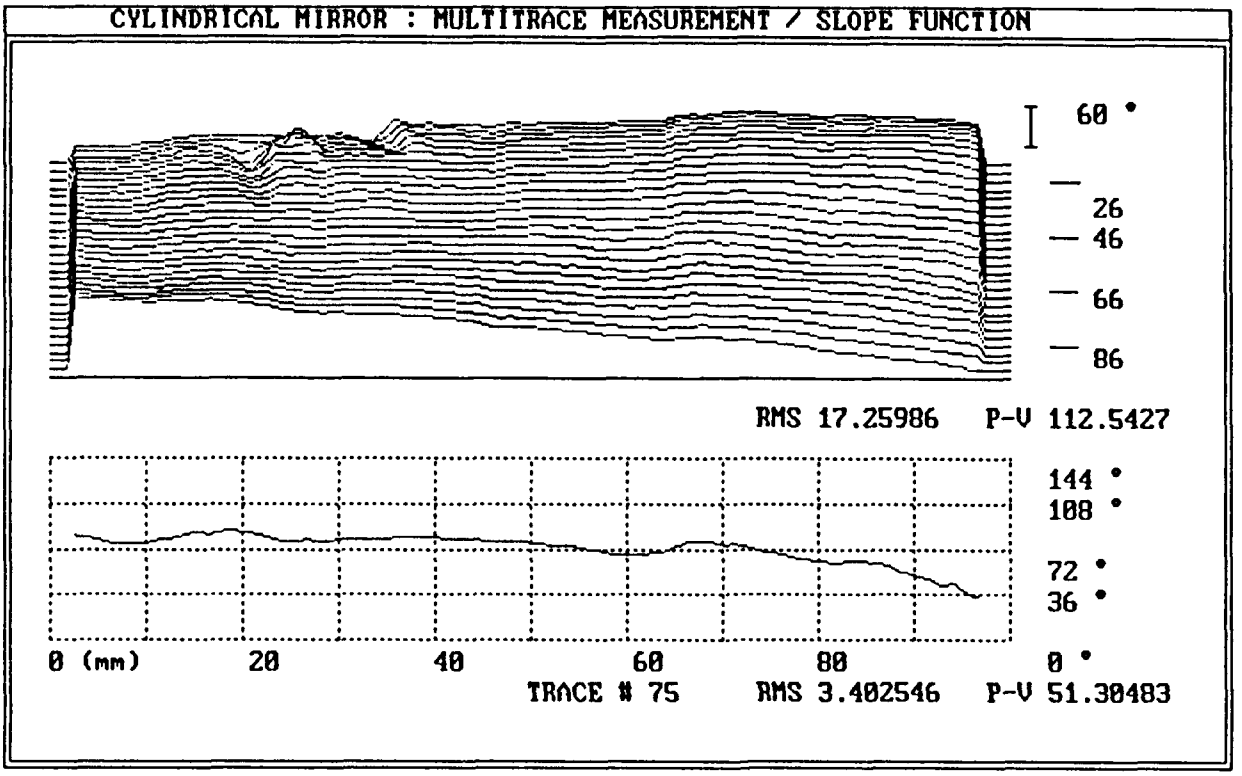

CYLINDRICAL MIRROR : MULTITRACE MEASUREMENT / SLOPE FUNCTION
60
26
46
66
86
RMS 17.25986 P-V 112.5427
144
108
72
36
0
0 (mm)
20
40
60
80
TRACE # 50 RMS 6.345053 P-V 44.41621

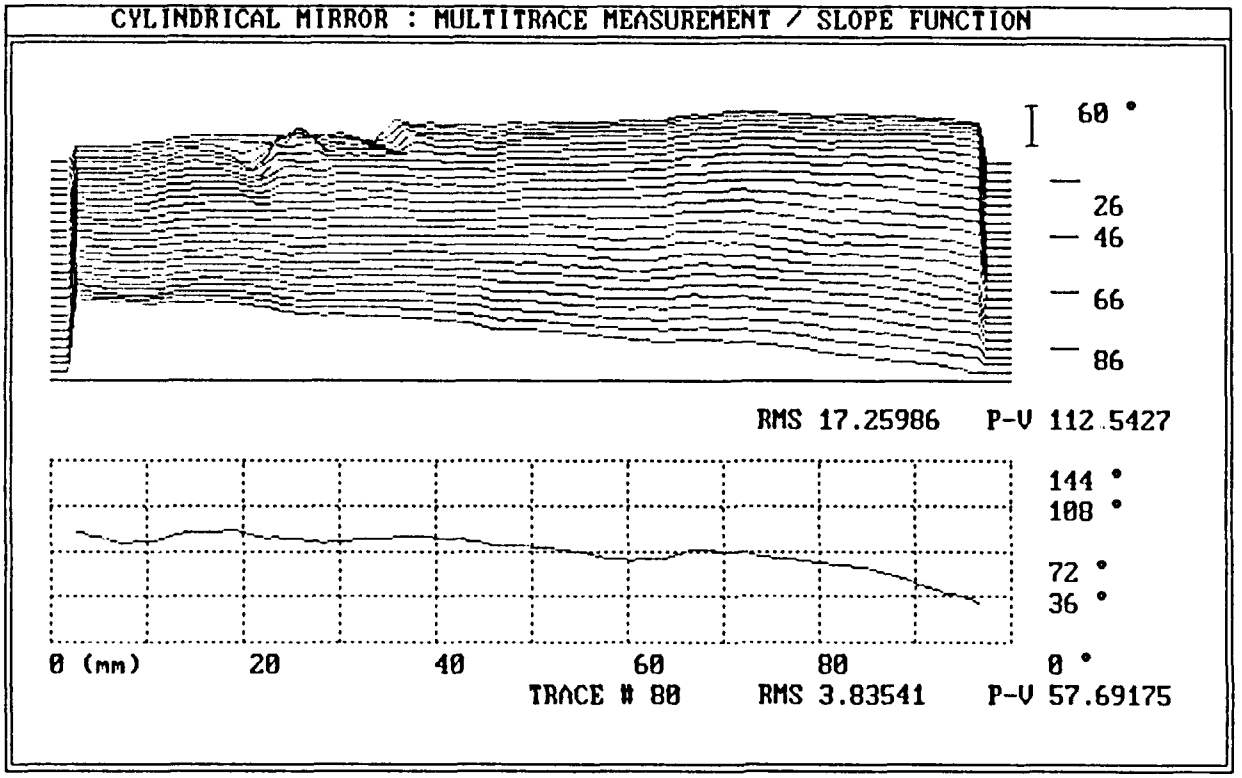

CYLINDRICAL MIRROR : MULTITRACE MEASUREMENT / SLOPE FUNCTION
60 •
26
46
66
86
RMS 17.25986 P-V 112.5427
144 •
108 •
72 •
36 •
0 •
0 (mm)
20
40
60
80
TRACE # 55 RMS 4.622995 P-V 37.36874

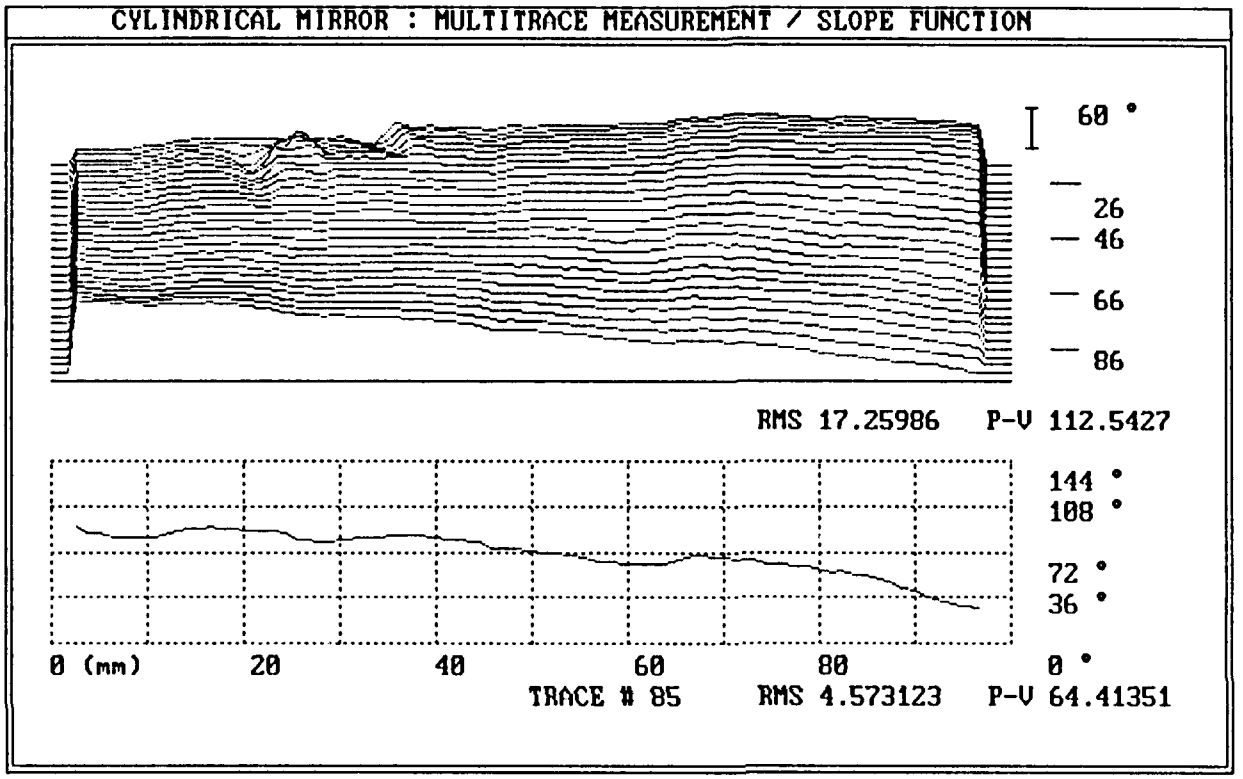

CYLINDRICAL MIRROR : MULTITRACE MEASUREMENT / SLOPE FUNCTION
60
26
46
66
86
RMS 17.25986 P-V 112.5427
144
108
72
36
0
0 (mm)
20
40
60
80
TRACE # 60
RMS 3.246115
P-V 31.79525

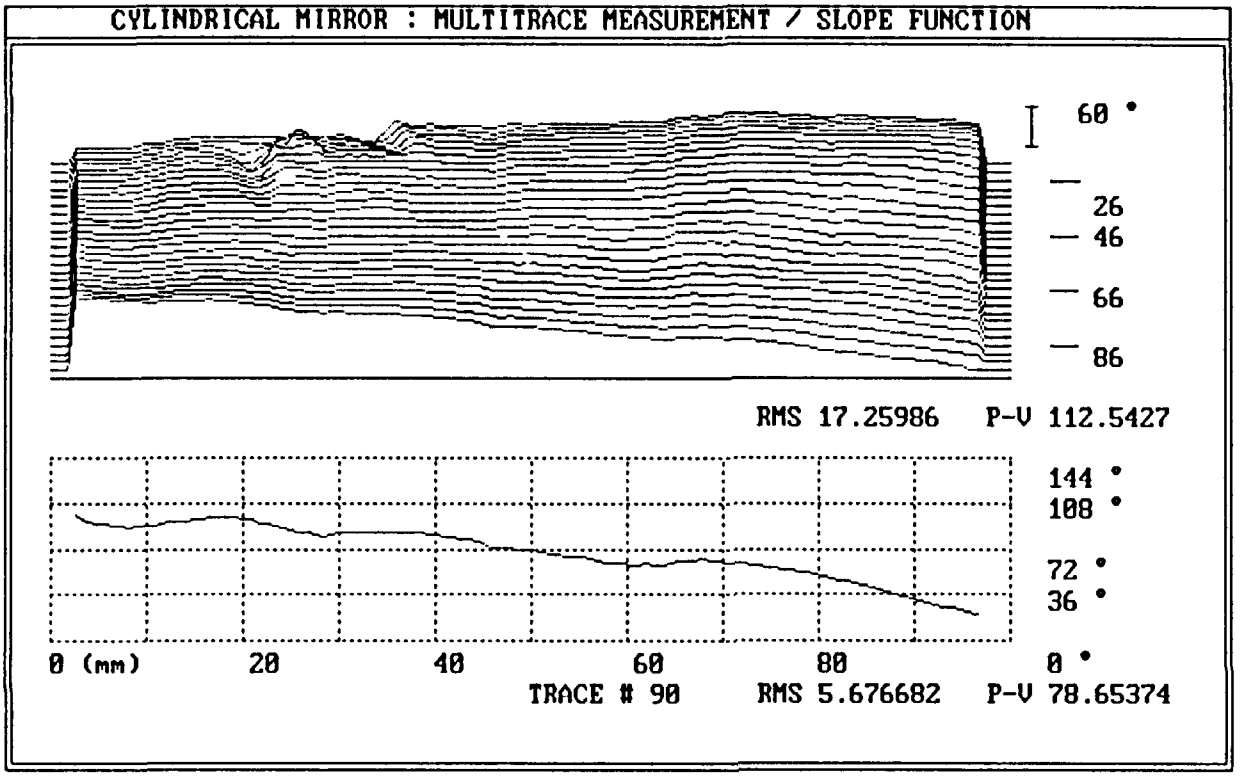

CYLINDRICAL MIRROR : MULTITRACE MEASUREMENT / SLOPE FUNCTION
60 •
26
46
66
86
RMS 17.25986 P-V 112.5427
144 •
108 •
72 •
36 •
0 •
0 (mm)
20
40
60
80
TRACE # 65 RMS 2.661066 P-V 37.34784

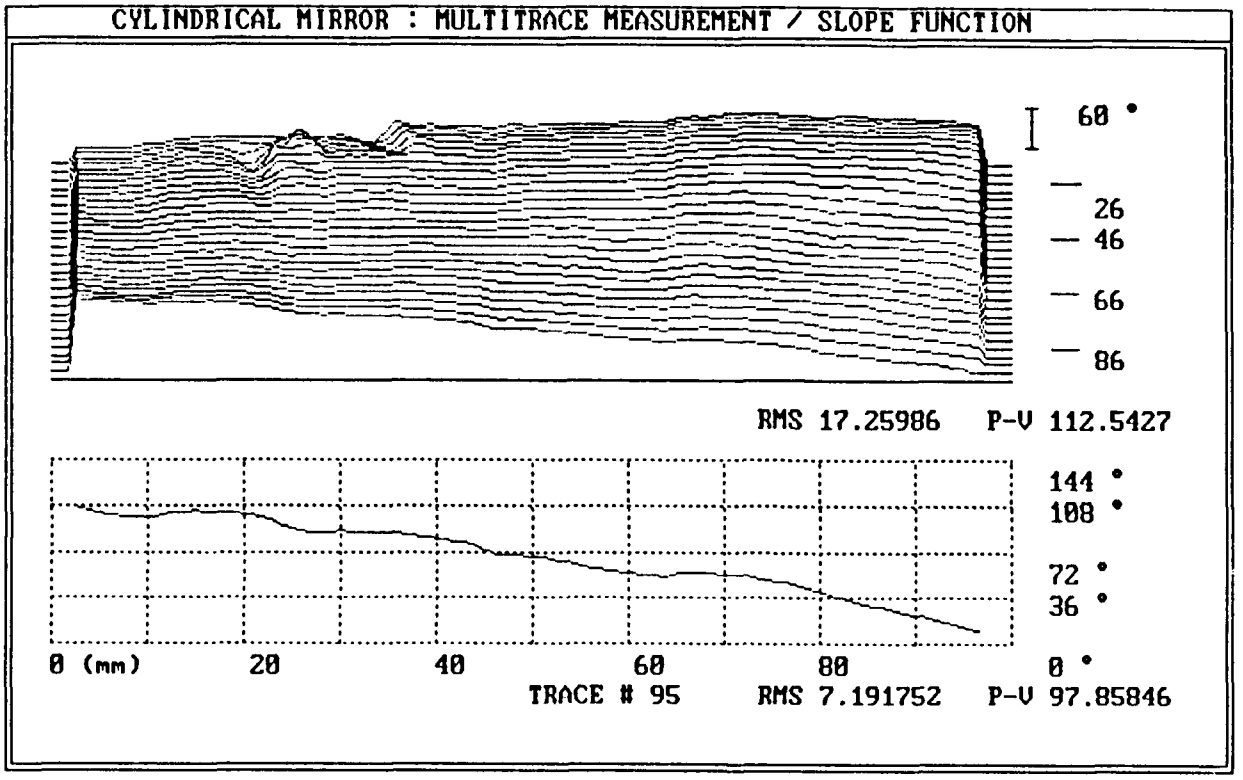

CYLINDRICAL MIRROR : MULTITRACE MEASUREMENT / SLOPE FUNCTION
60 •
26
46
66
86
RMS 17.25986 P-V 112.5427
144 •
108 •
72 •
36 •
0 •
0 (mm)
20
40
60
80
TRACE # 70 RMS 2.678192 P-V 41.50981

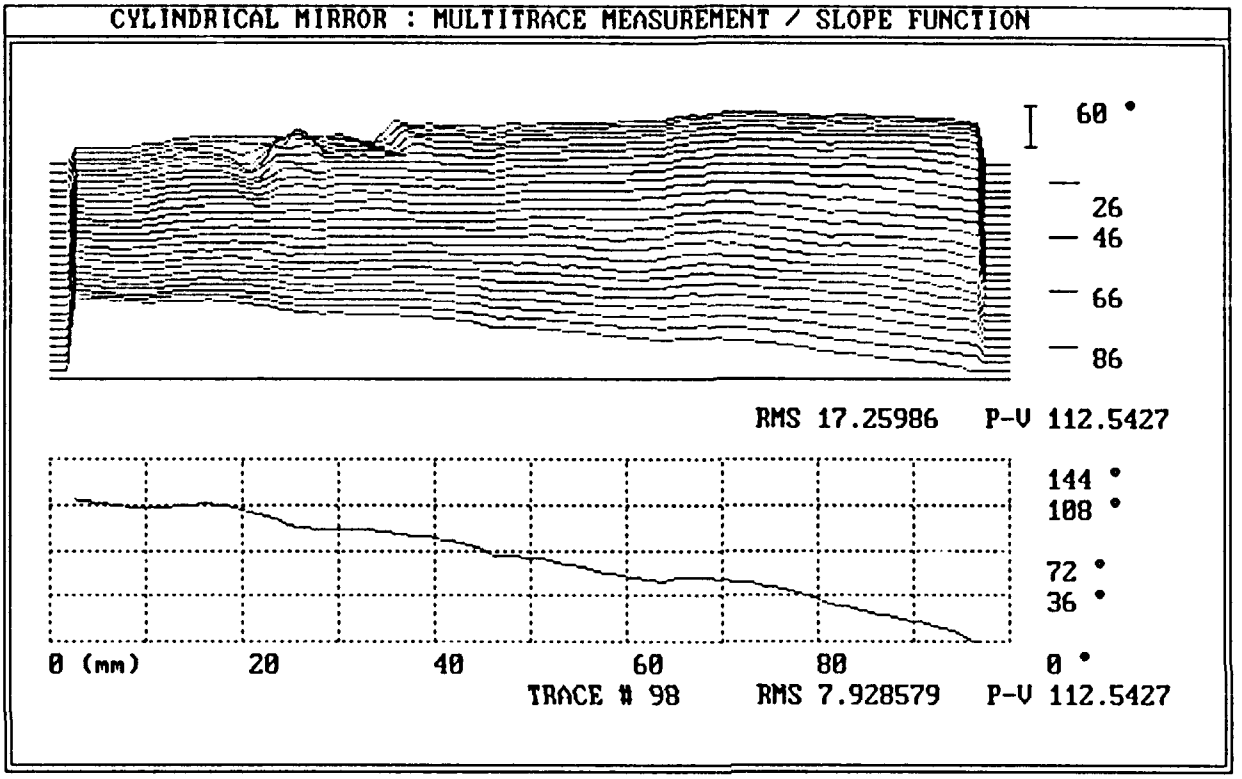

CYLINDRICAL MIRROR : MULTITRACE MEASUREMENT / SLOPE FUNCTION
60 •
26
46
66
86
RMS 17.25986 P-V 112.5427
144 •
108 •
72 •
36 •
0 •
0 (mm)
20
40
60
80
TRACE # 75
RMS 3.402546
P-V 51.30483

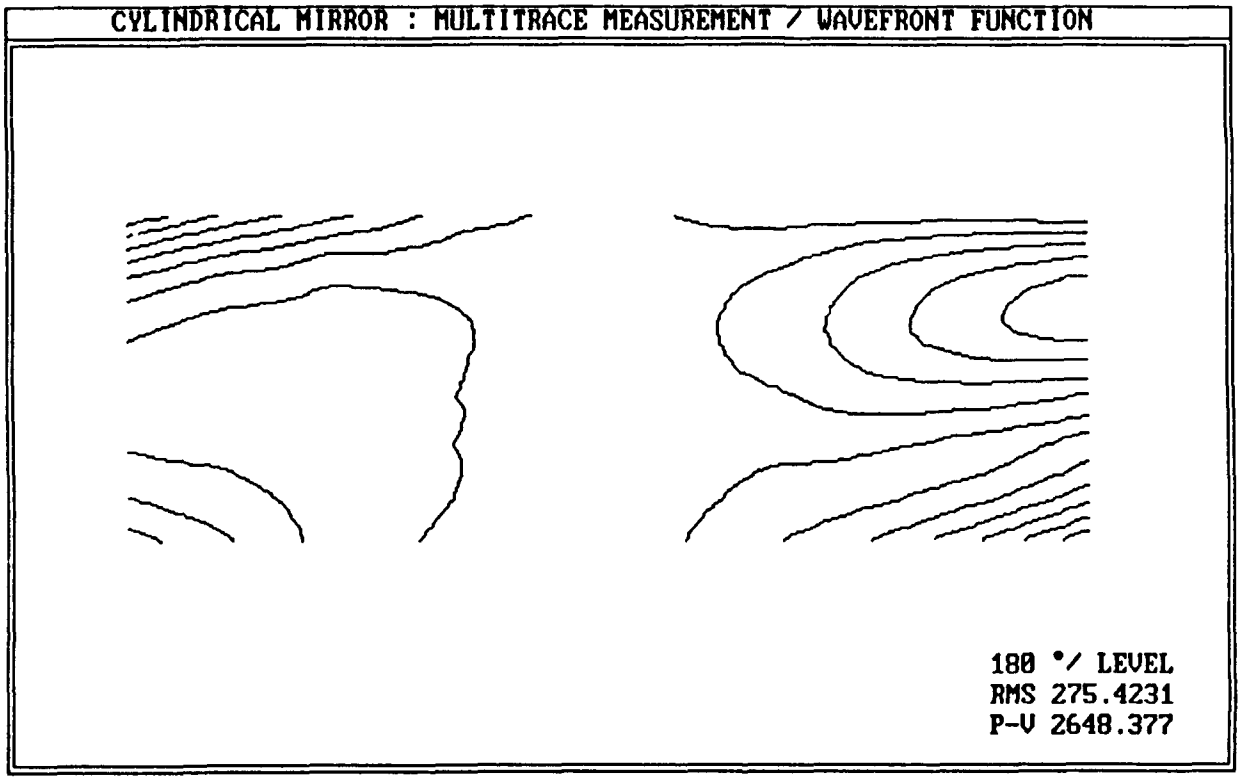

CYLINDRICAL MIRROR : MULTITRACE MEASUREMENT / SLOPE FUNCTION
60 "
26
46
66
86
RMS 17.25986 P-V 112.5427
144 "
108 "
72 "
36 "
0 "
0 (mm)
20
40
60
80
TRACE # 80 RMS 3.83541 P-V 57.69175

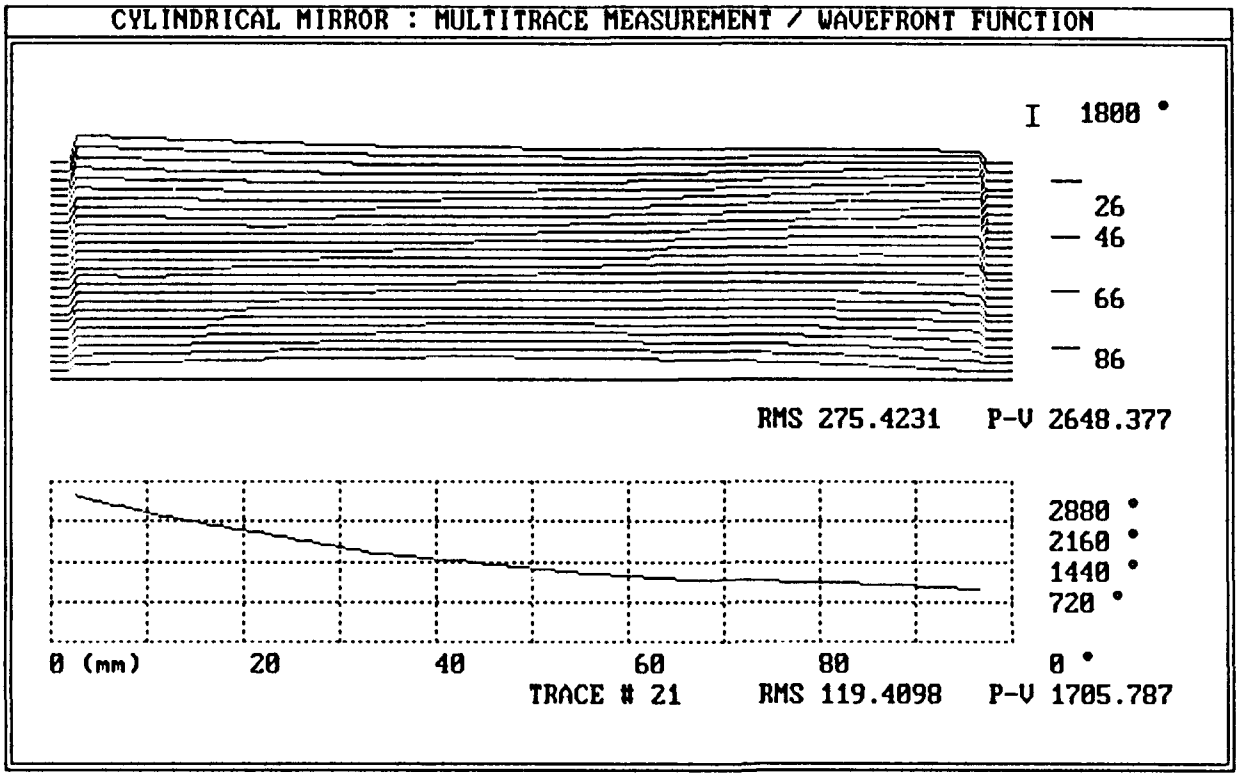

CYLINDRICAL MIRROR : MULTITRACE MEASUREMENT / SLOPE FUNCTION
60 °
26
46
66
86
RMS 17.25986 P-V 112.5427
144 °
108 °
72 °
36 °
0 °
0 (mm)
20
40
60
80
TRACE # 85
RMS 4.573123
P-V 64.41351

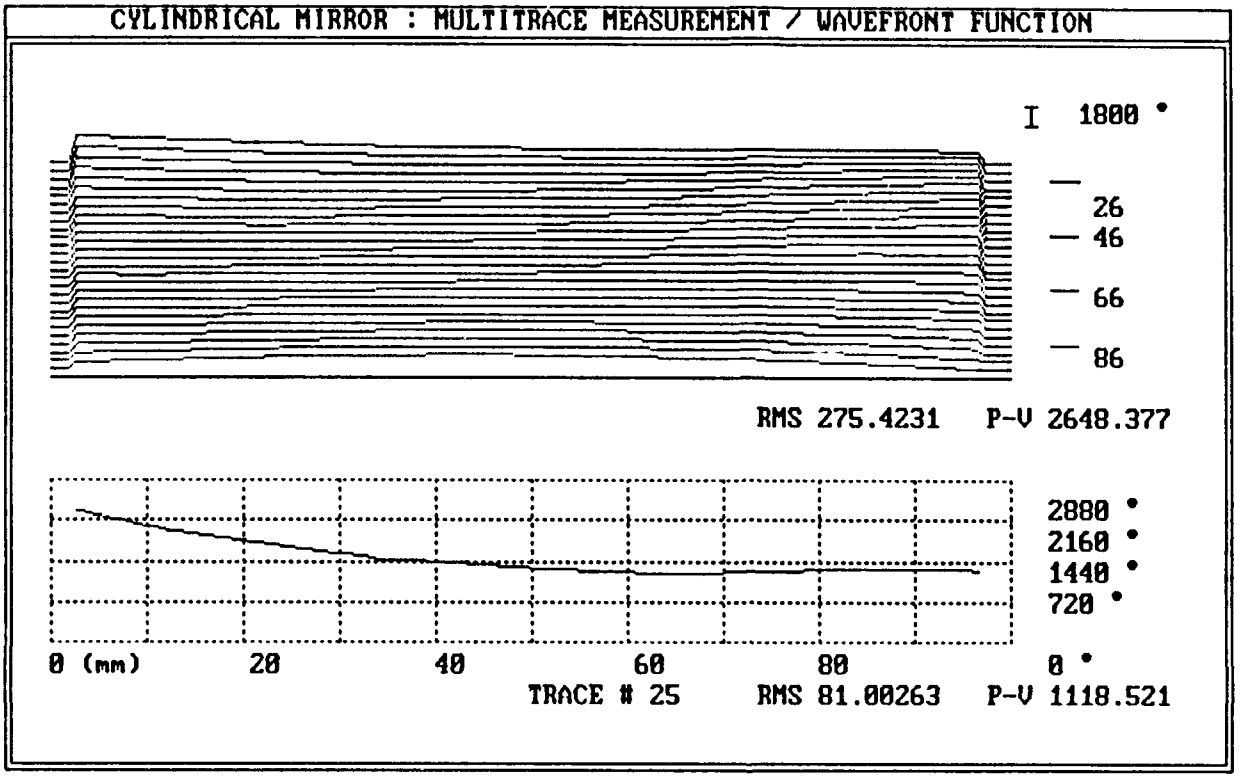

CYLINDRICAL MIRROR : MULTITRACE MEASUREMENT / SLOPE FUNCTION
60 "
26
46
66
86
RMS 17.25986 P-V 112.5427
144 "
108 "
72 "
36 "
0 "
0 (mm)
20
40
60
80
TRACE # 90
RMS 5.676682 P-V 78.65374

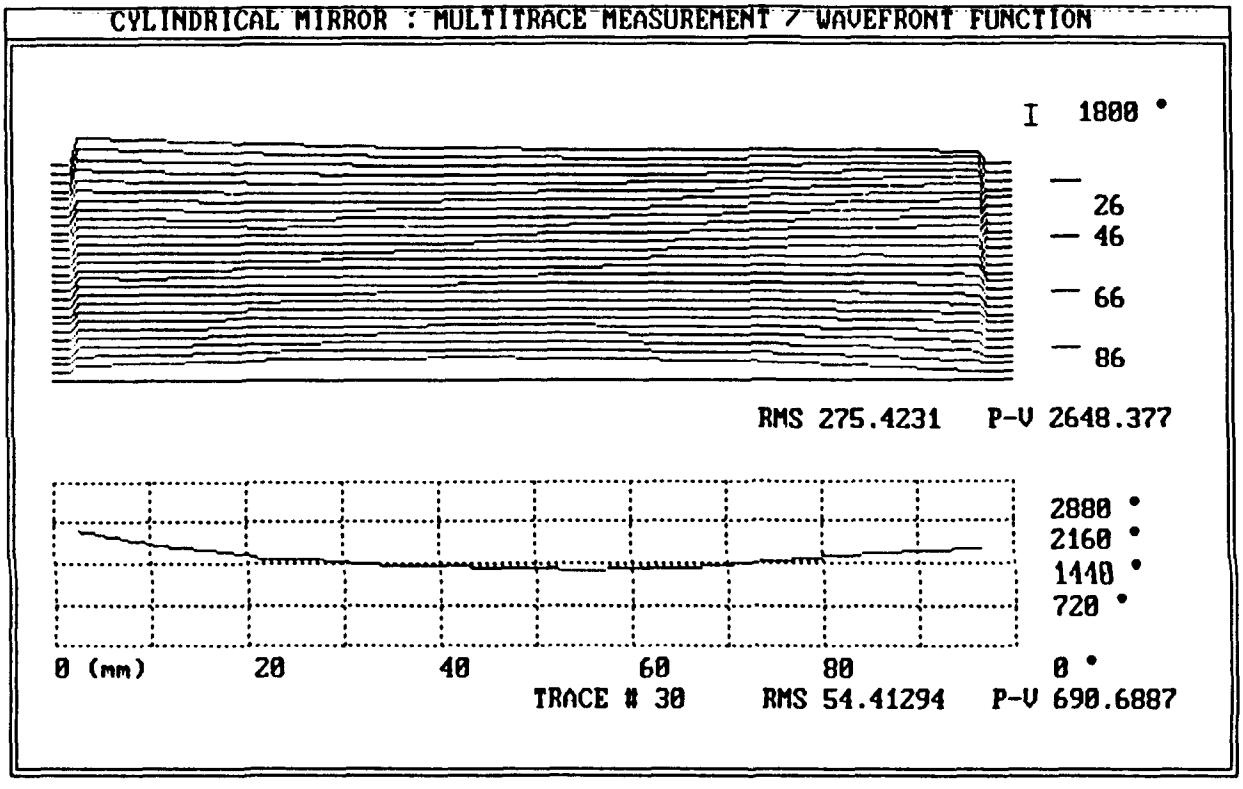

CYLINDRICAL MIRROR : MULTITRACE MEASUREMENT / SLOPE FUNCTION
60 •
26
46
66
86
RMS 17.25986 P-V 112.5427
144 •
108 •
72 •
36 •
0 •
0 (mm)
20
40
60
80
TRACE # 95
RMS 7.191752
P-V 97.85846

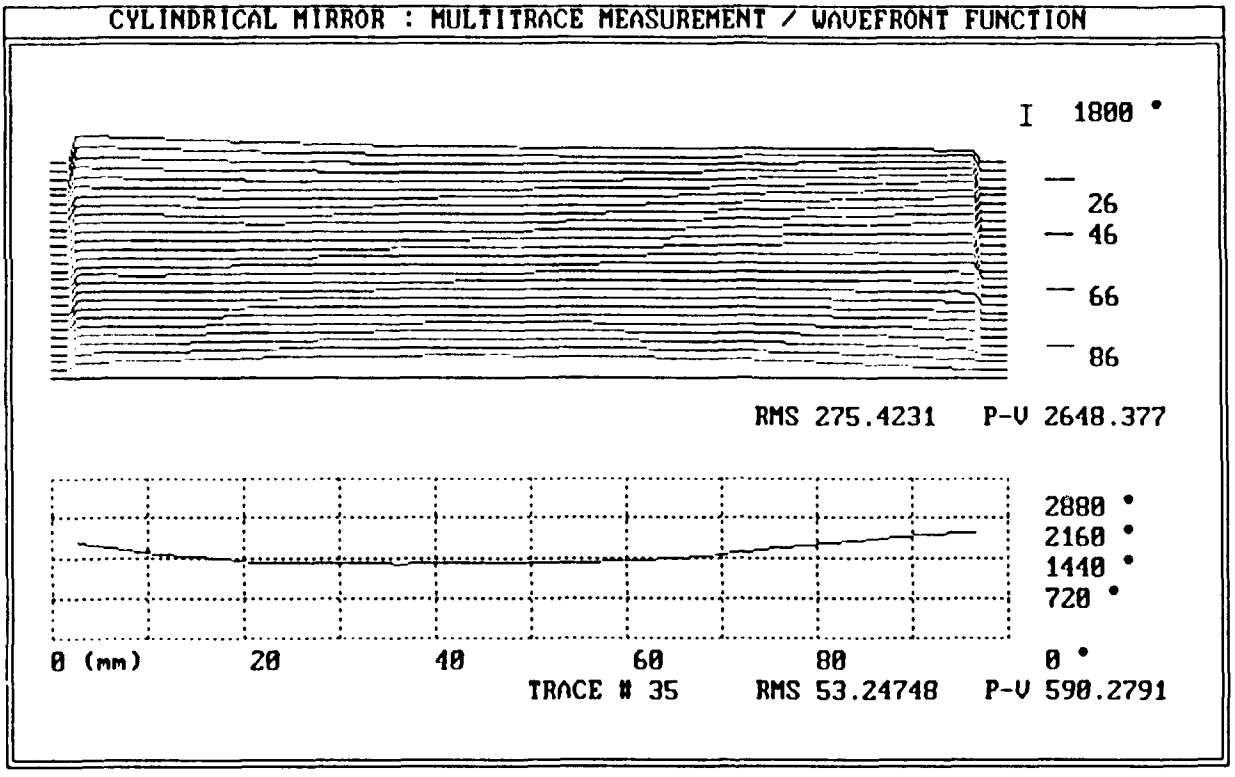

CYLINDRICAL MIRROR : MULTITRACE MEASUREMENT / SLOPE FUNCTION
60 •
26
46
66
86
RMS 17.25986 P-V 112.5427
144 •
108 •
72 •
36 •
0 •
0 (mm)
20
40
60
80
TRACE # 98
RMS 7.928579 P-V 112.5427

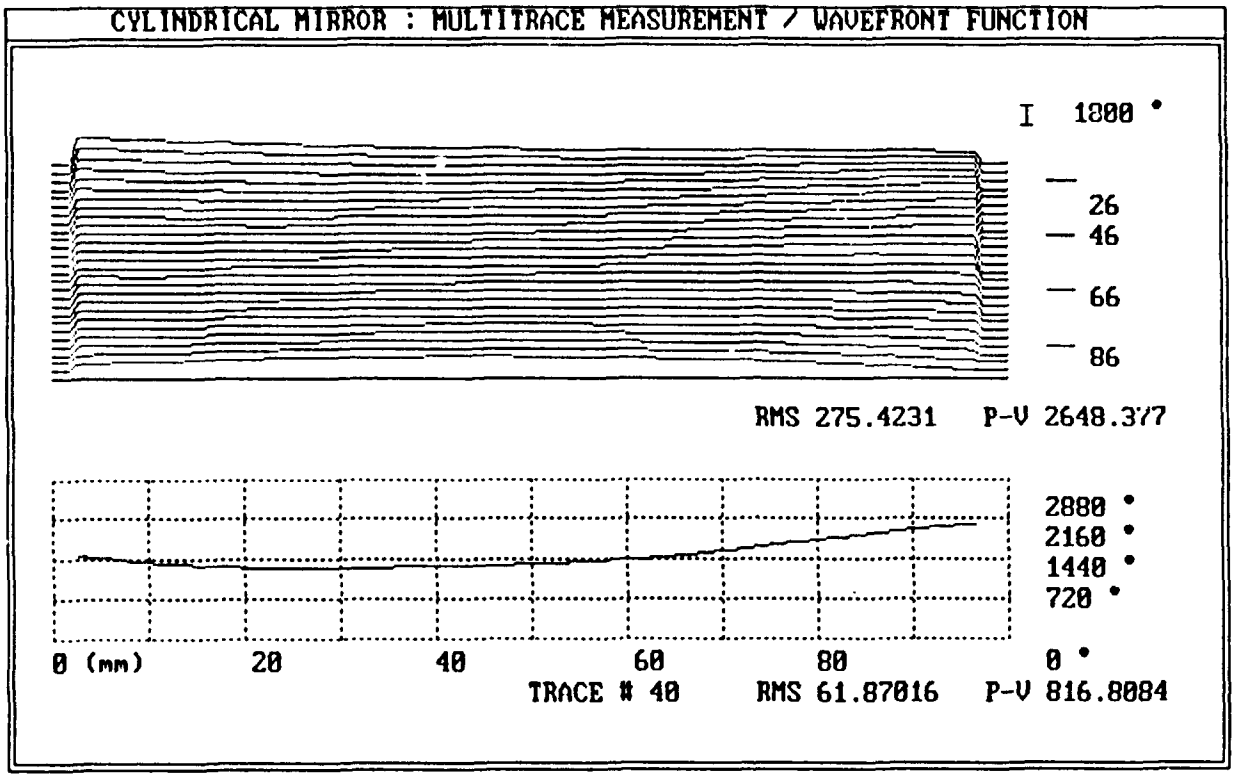

CYLINDRICAL MIRROR : MULTITRACE MEASUREMENT / WAVEFRONT FUNCTION
180 °/ LEVEL
RMS 275.4231
P-V 2648.377

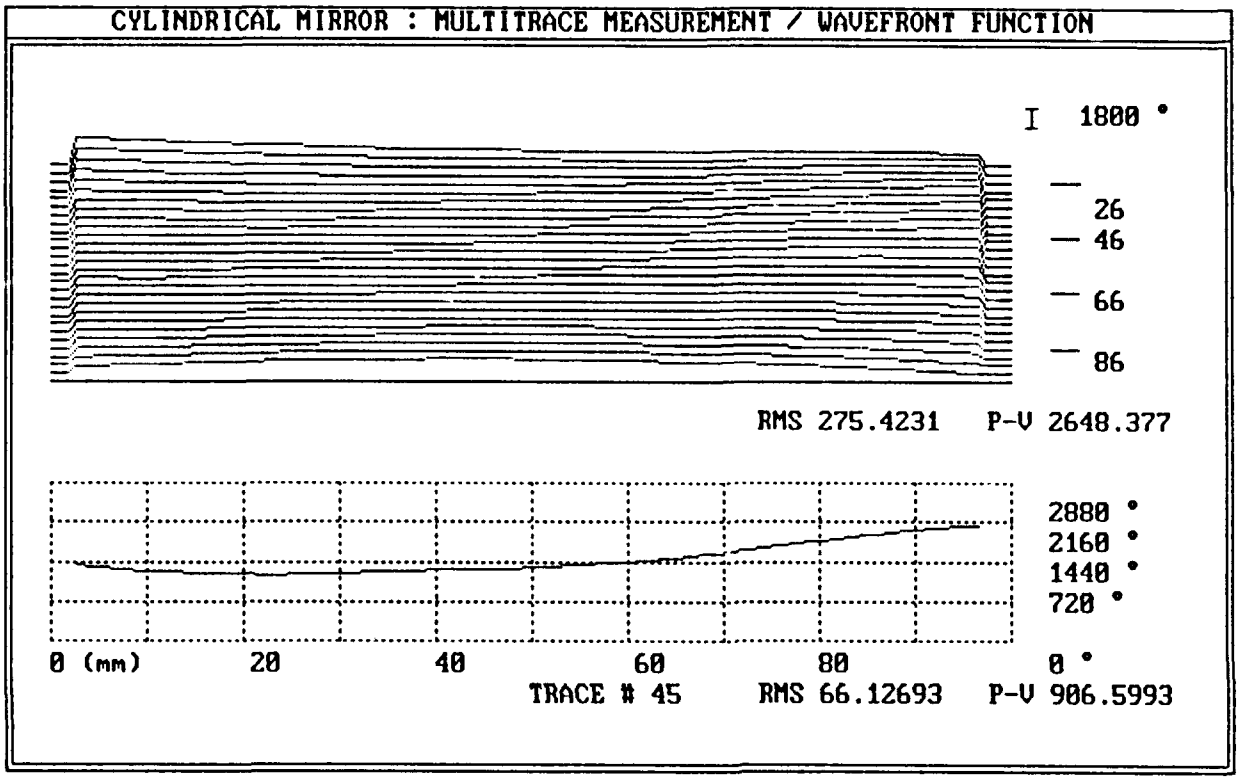

CYLINDRICAL MIRROR : MULTITRACE MEASUREMENT / WAVEFRONT FUNCTION
I 1800 •
26
46
66
86
RMS 275.4231 P-V 2648.377
2880 •
2160 •
1440 •
720 •
0 (mm) 20 40 60 80 0 •
TRACE # 21 RMS 119.4098 P-V 1705.787

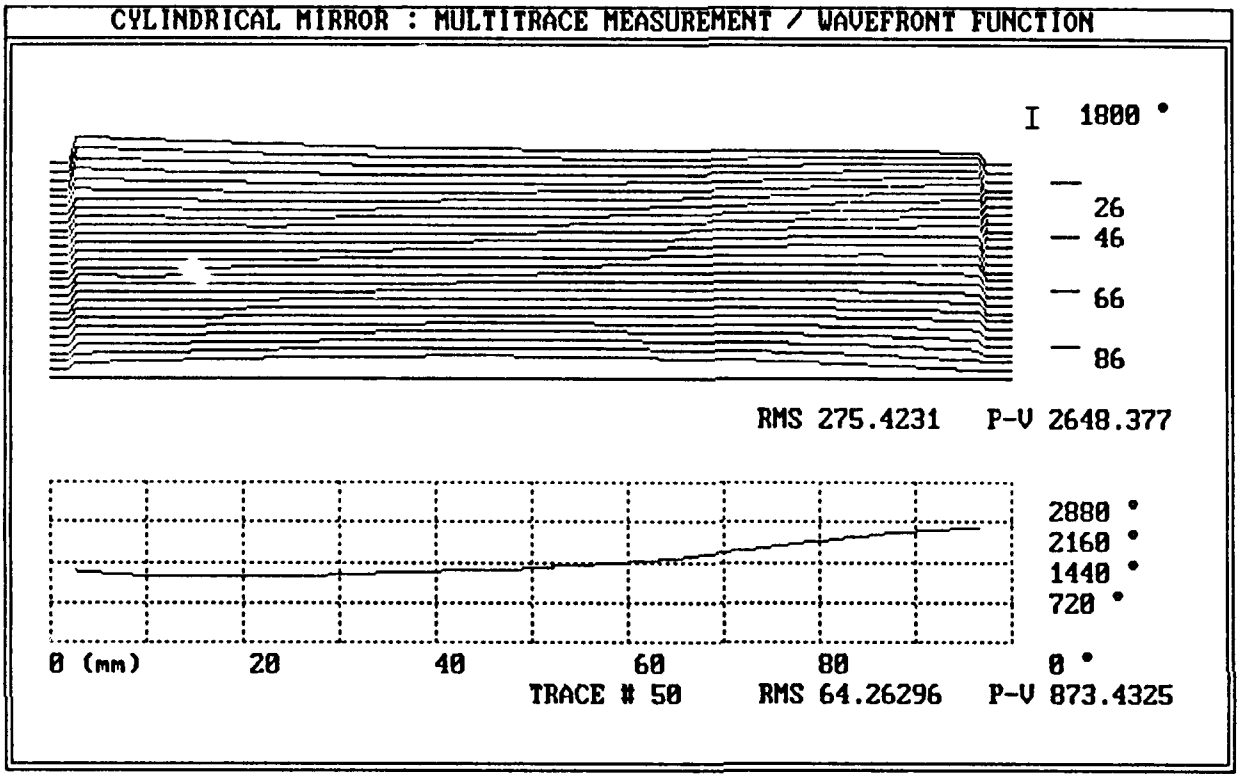

CYLINDRICAL MIRROR : MULTITRACE MEASUREMENT / WAVEFRONT FUNCTION
I 1800 •
26
46
66
86
RMS 275.4231 P-V 2648.377
2880 •
2160 •
1440 •
720 •
0 •
0 (mm)
20
40
60
80
TRACE # 25 RMS 81.00263 P-V 1118.521

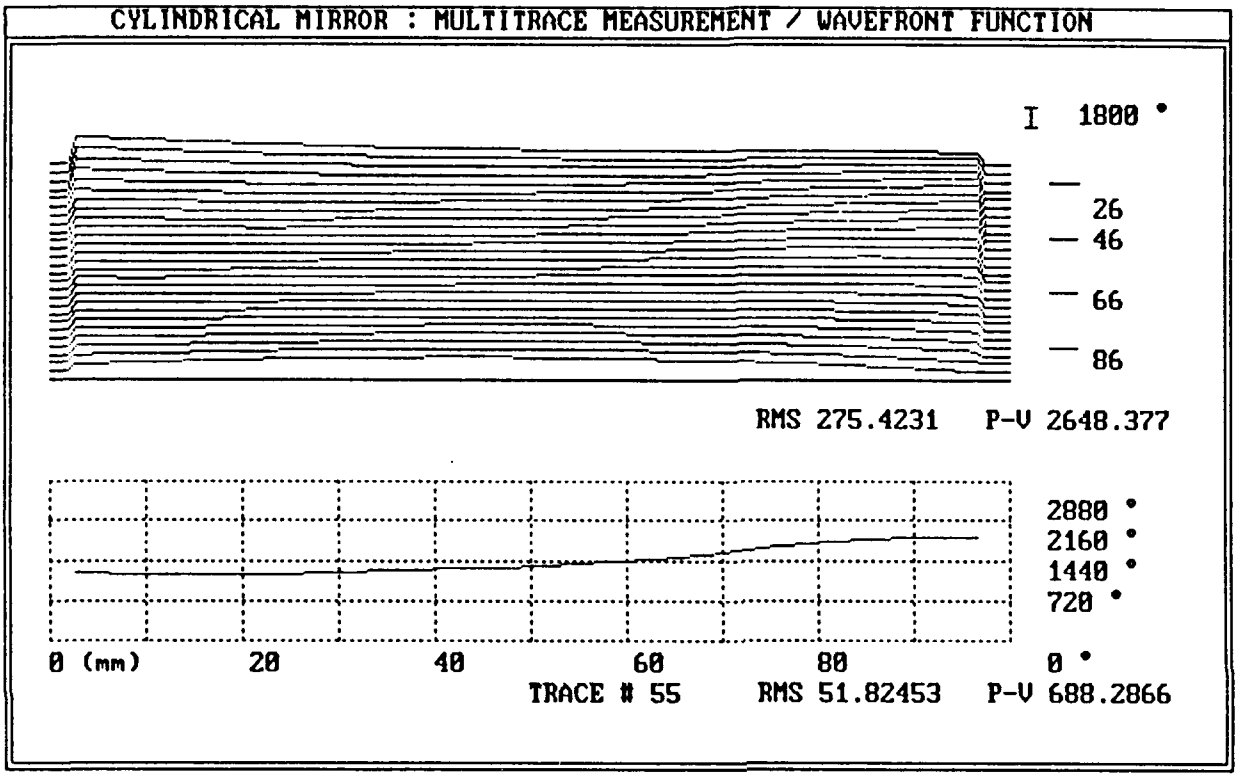

CYLINDRICAL MIRROR : MULTITRACE MEASUREMENT / WAVEFRONT FUNCTION
I 1800 •
26
46
66
86
RMS 275.4231 P-V 2648.377
2880 •
2160 •
1440 •
720 •
0 •
0 (mm)
20
40
60
80
TRACE # 30 RMS 54.41294 P-V 690.6887

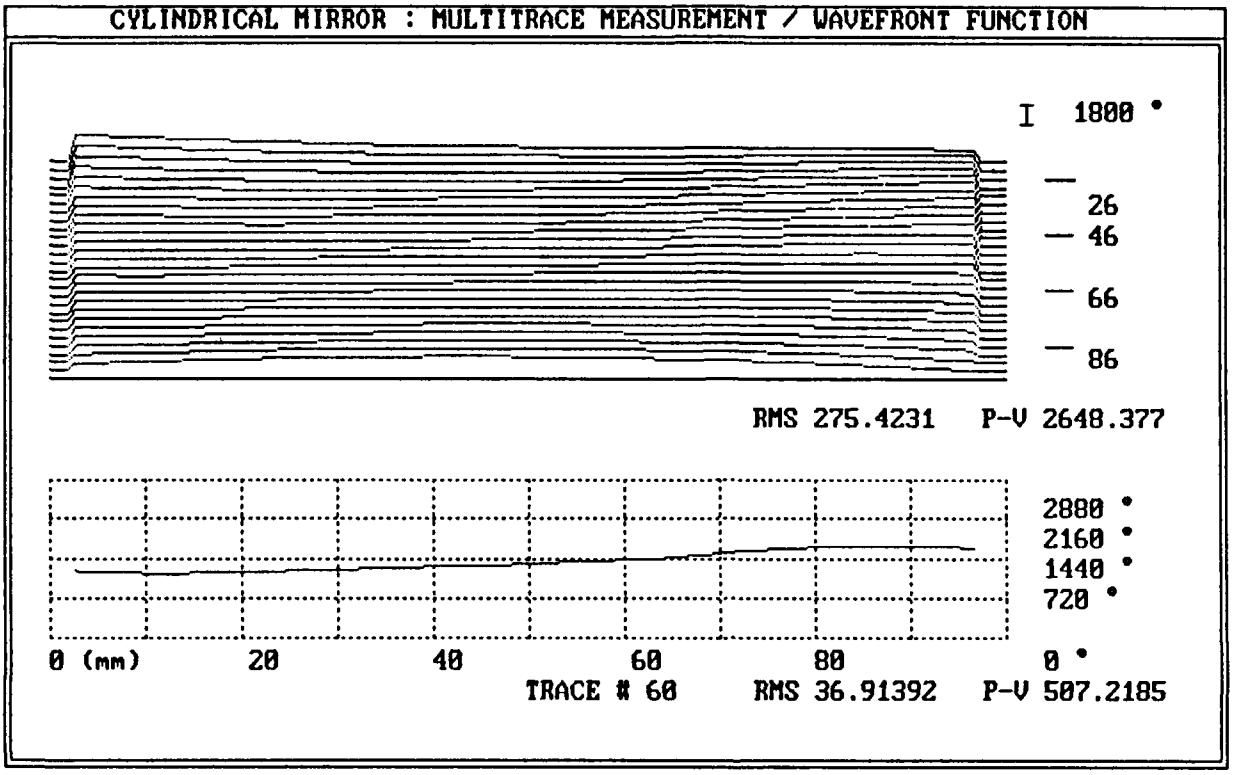

CYLINDRICAL MIRROR : MULTITRACE MEASUREMENT / WAVEFRONT FUNCTION
I 1800 •
26
46
66
86
RMS 275.4231 P-V 2648.377
2880 •
2160 •
1440 •
720 •
0 •
0 (mm)
20
40
60
80
TRACE # 35
RMS 53.24748 P-V 590.2791

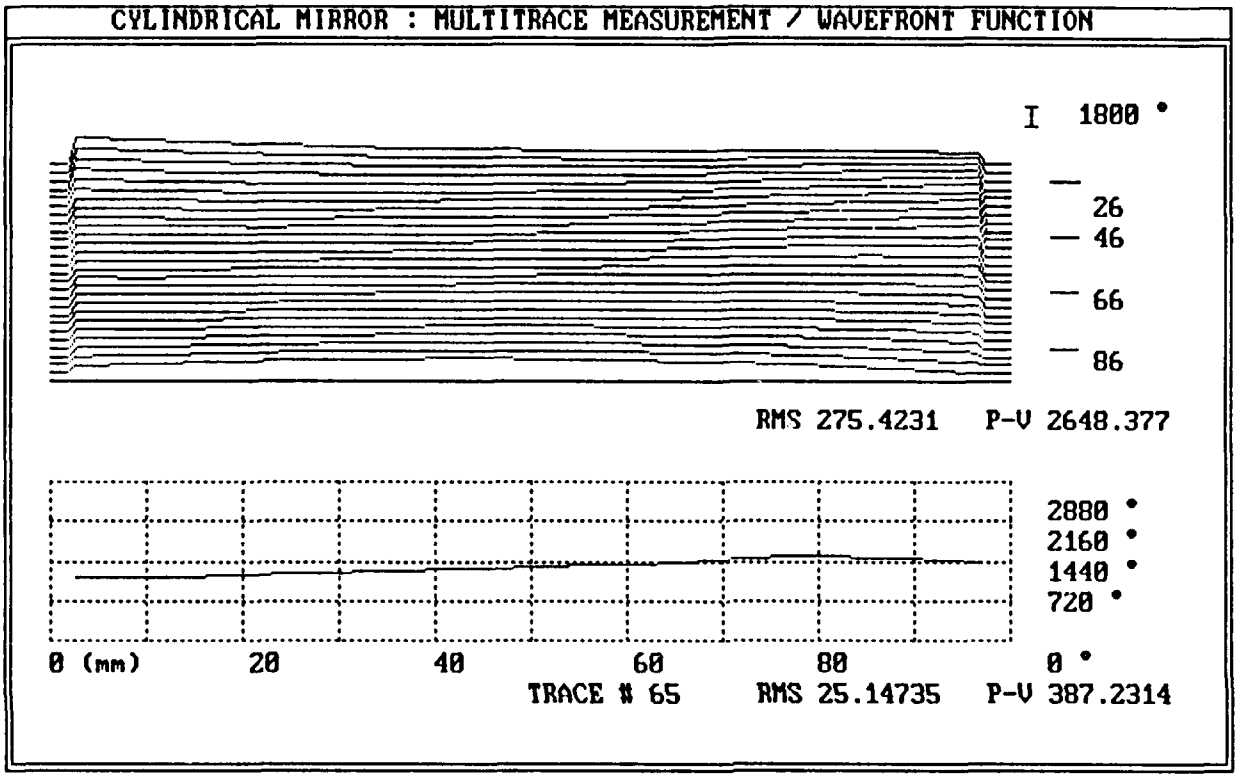

CYLINDRICAL MIRROR : MULTITRACE MEASUREMENT / WAVEFRONT FUNCTION
I 1800 •
26
46
66
86
RMS 275.4231 P-V 2648.377
2880 •
2160 •
1440 •
720 •
0 •
0 (mm)
20
40
60
80
TRACE # 40 RMS 61.87016 P-V 816.8084

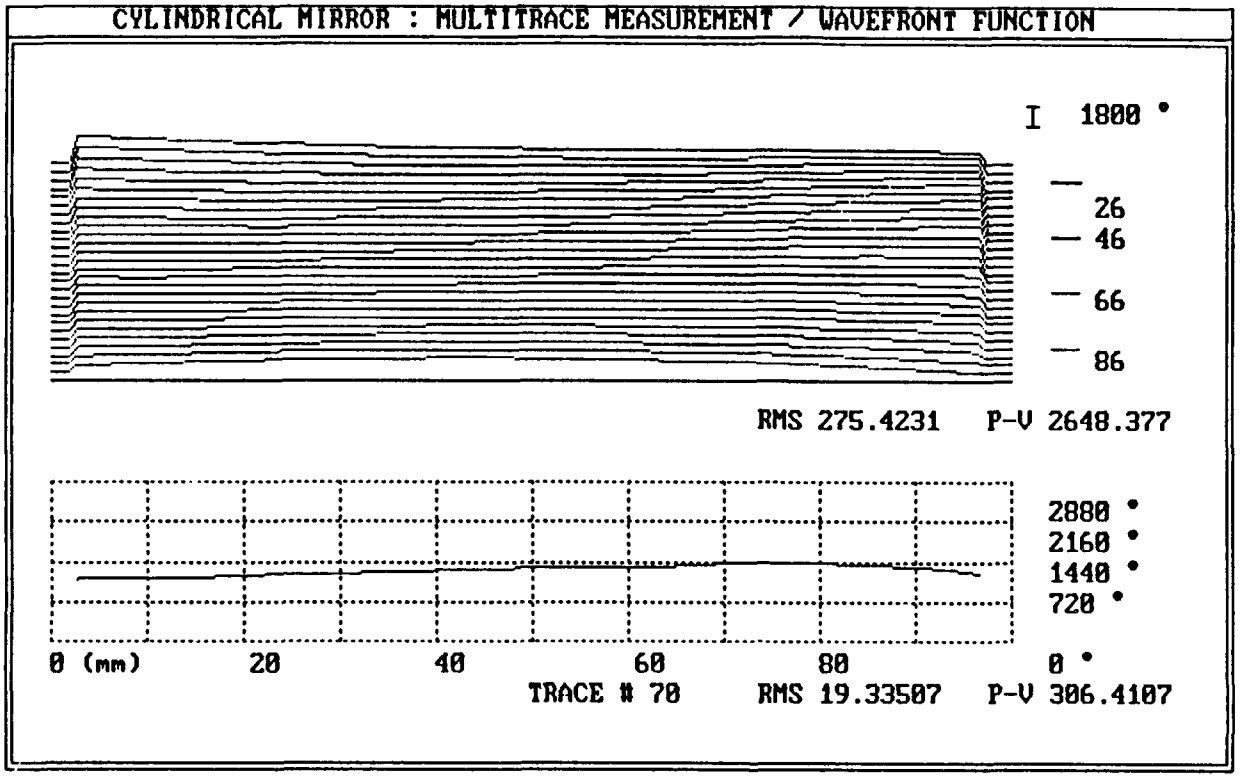

CYLINDRICAL MIRROR : MULTITRACE MEASUREMENT / WAVEFRONT FUNCTION
I 1800 °
26
46
66
86
RMS 275.4231 P-V 2648.377
2880 °
2160 °
1440 °
720 °
0 (mm)
20
40
60
80
0 °
TRACE # 45
RMS 66.12693 P-V 906.5993

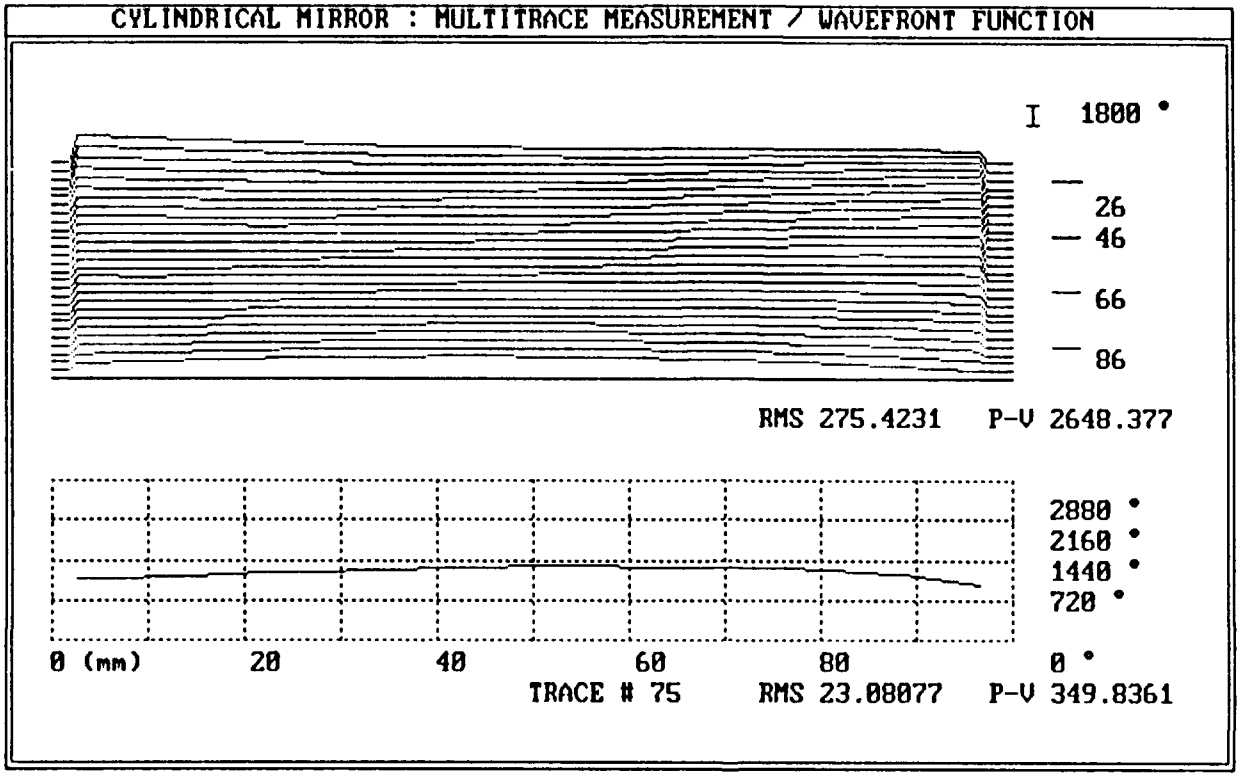

CYLINDRICAL MIRROR : MULTITRACE MEASUREMENT / WAVEFRONT FUNCTION
I 1800 •
26
46
66
86
RMS 275.4231 P-V 2648.377
2880 •
2160 •
1440 •
720 •
0 (mm)
20
40
60
80
0 •
TRACE # 50
RMS 64.26296
P-V 873.4325

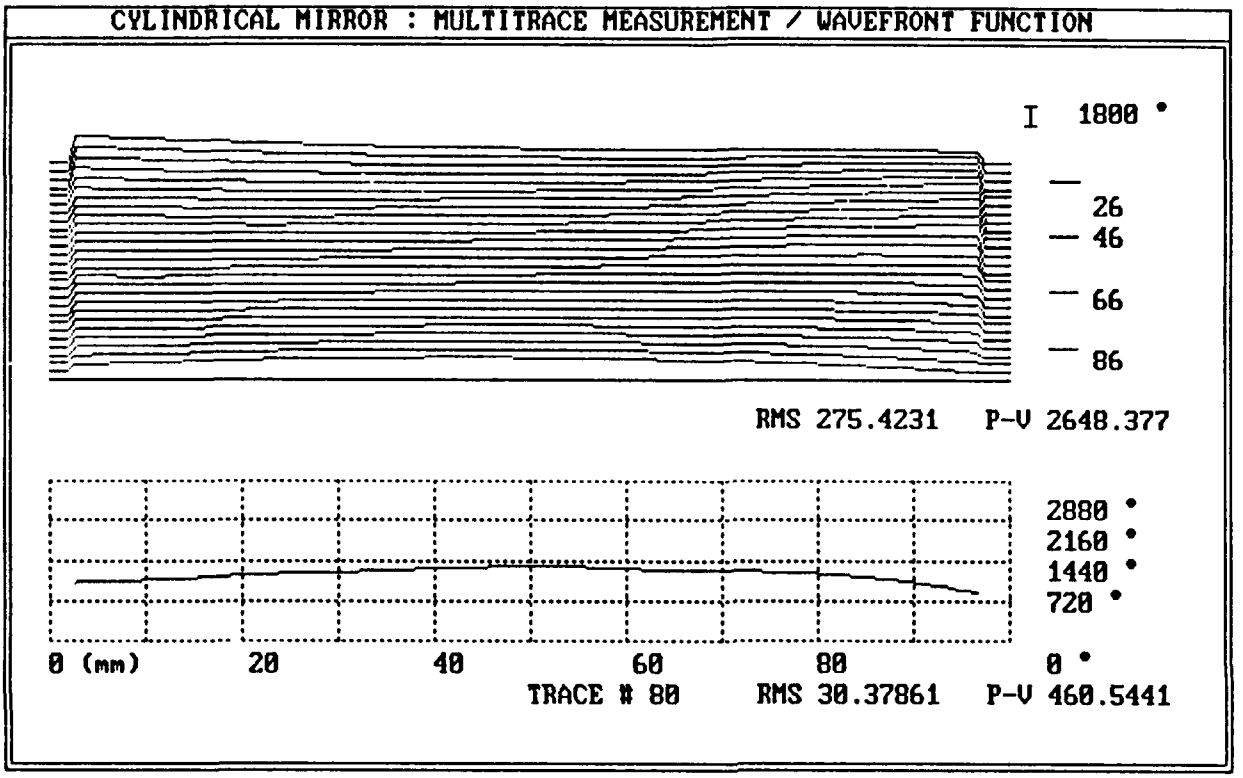

CYLINDRICAL MIRROR : MULTITRACE MEASUREMENT / WAVEFRONT FUNCTION
I 1800 •
26
46
66
86
RMS 275.4231 P-V 2648.377
2880 •
2160 •
1440 •
720 •
0 •
0 (mm)
20
40
60
80
TRACE # 55 RMS 51.82453 P-V 688.2866

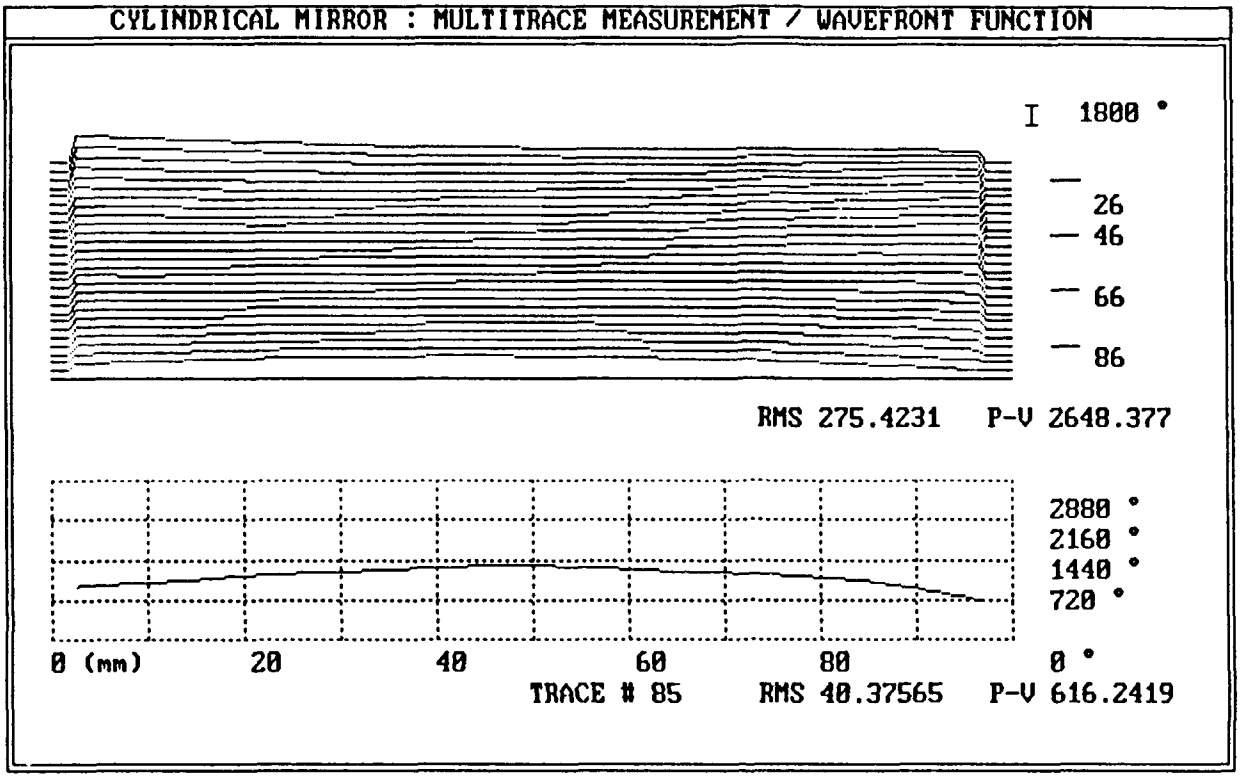

CYLINDRICAL MIRROR : MULTITRACE MEASUREMENT / WAVEFRONT FUNCTION
I 1800 •
26
46
66
86
RMS 275.4231 P-V 2648.377
2880 •
2160 •
1440 •
720 •
0 (mm) 20 40 60 80 0 •
TRACE # 60 RMS 36.91392 P-V 507.2185

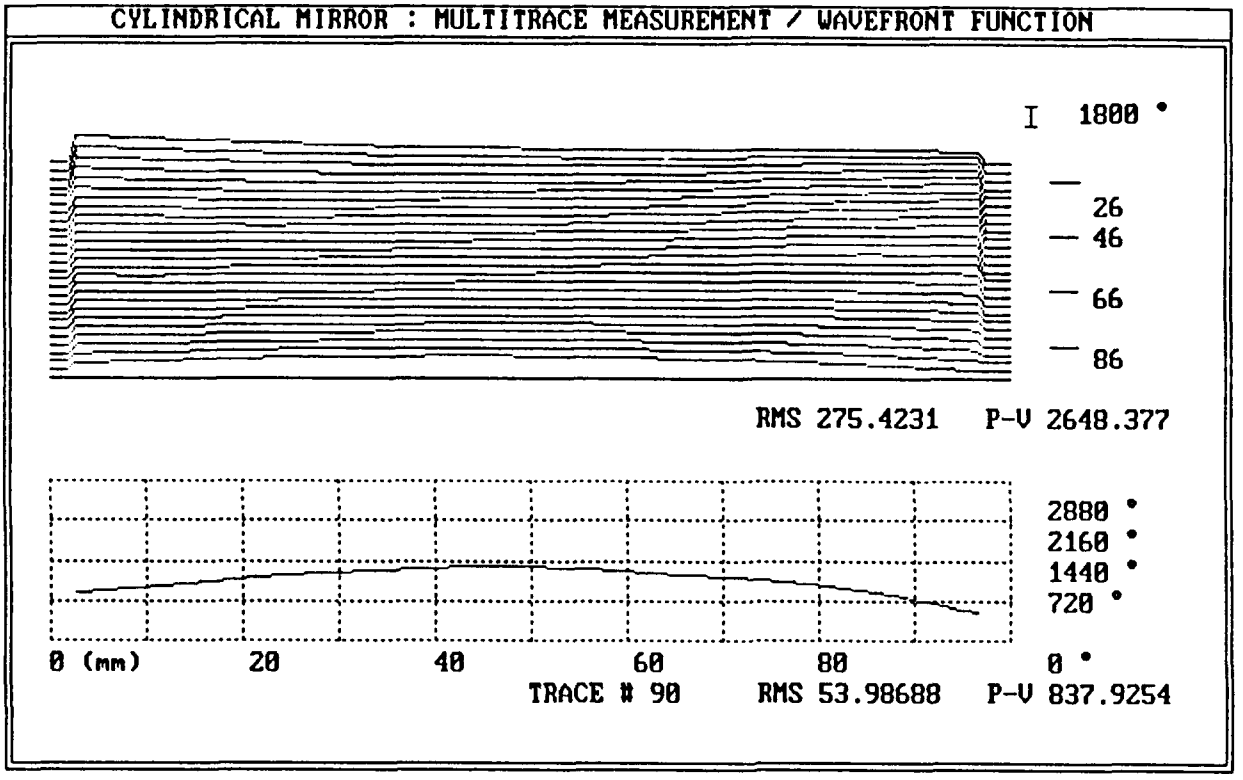

CYLINDRICAL MIRROR : MULTITRACE MEASUREMENT / WAVEFRONT FUNCTION
I 1800 •
26
46
66
86
RMS 275.4231 P-V 2648.377
2880 •
2160 •
1440 •
720 •
0 •
0 (mm)
20
40
60
80
TRACE # 65 RMS 25.14735 P-V 387.2314

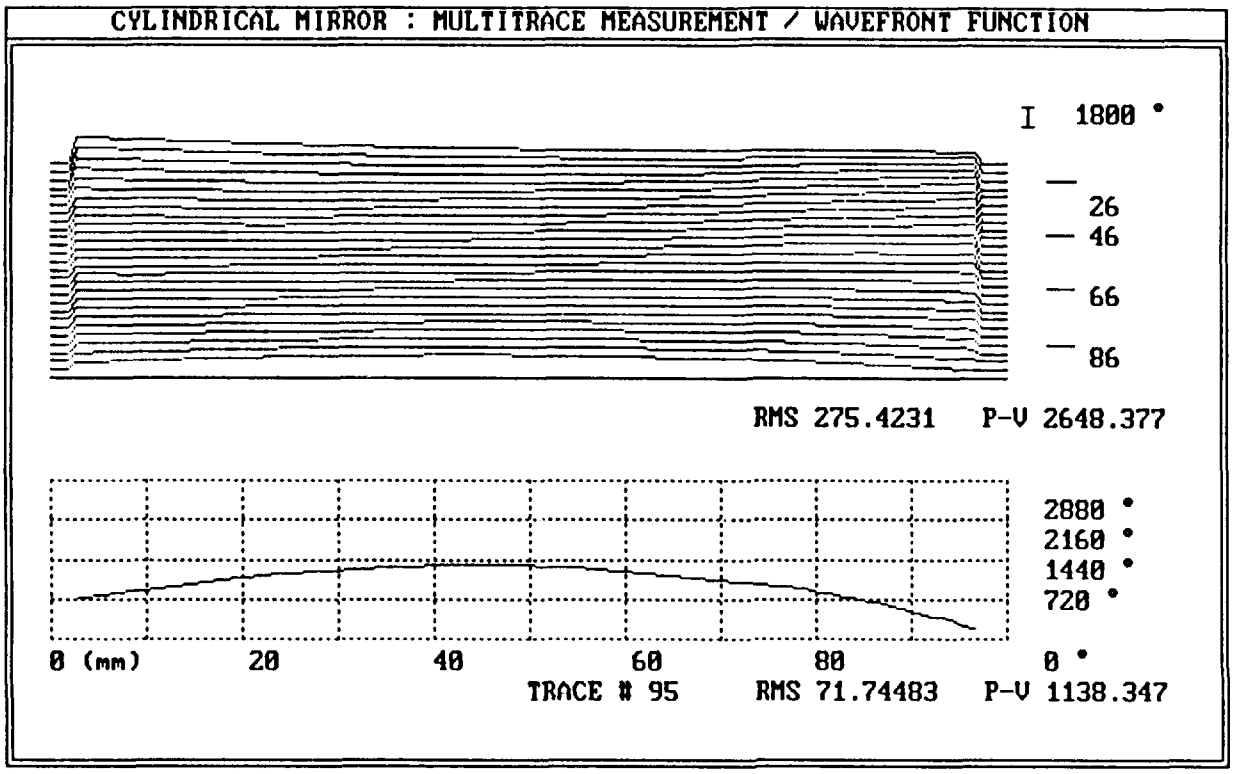

CYLINDRICAL MIRROR : MULTITRACE MEASUREMENT / WAVEFRONT FUNCTION
I 1800 •
26
46
66
86
RMS 275.4231 P-V 2648.377
2880 •
2160 •
1440 •
720 •
0 •
0 (mm) 20 40 60 80
TRACE # 70 RMS 19.33507 P-V 306.4107

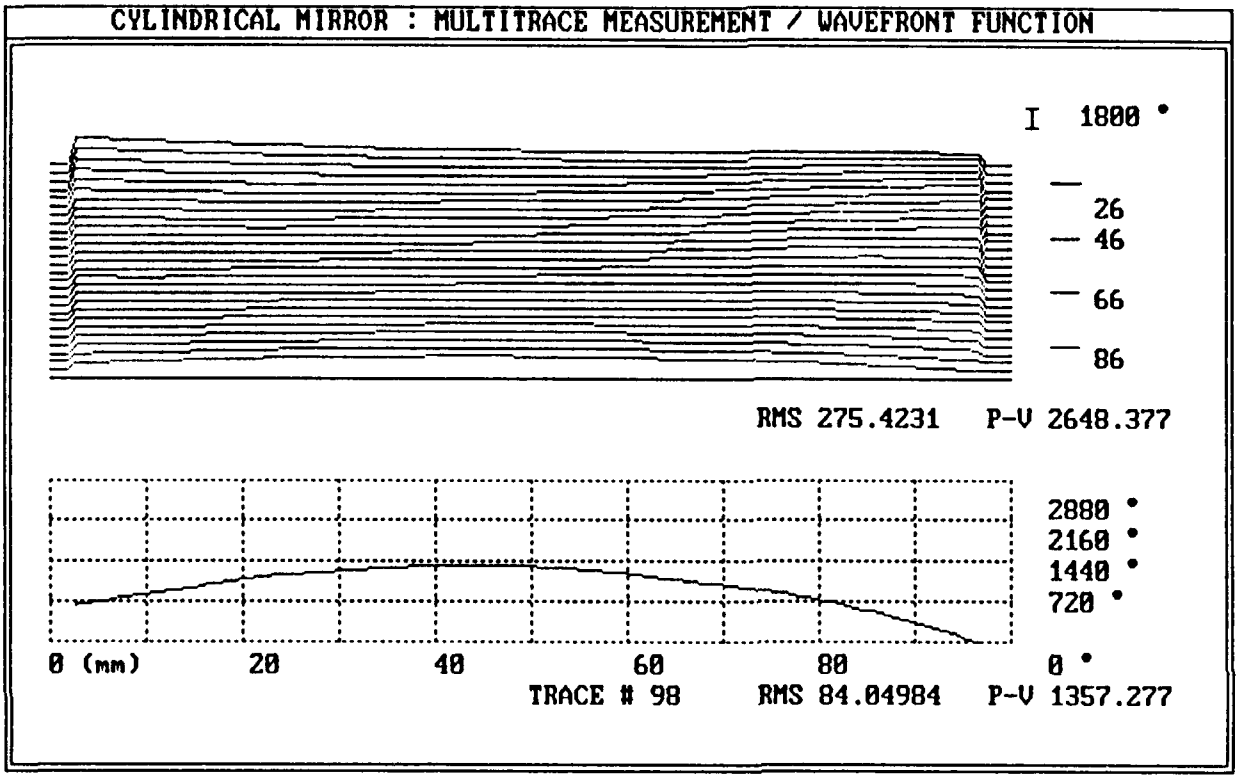

CYLINDRICAL MIRROR : MULTITRACE MEASUREMENT / WAVEFRONT FUNCTION
I 1800 •
26
46
66
86
RMS 275.4231 P-V 2648.377
2880 •
2160 •
1440 •
720 •
0 (mm) 20 40 60 80 0 •
TRACE # 75 RMS 23.08077 P-V 349.8361


CYLINDRICAL MIRROR : MULTITRACE MEASUREMENT / WAVEFRONT FUNCTION
I 1800 •
26
46
66
86
RMS 275.4231 P-V 2648.377
2880 •
2160 •
1440 •
720 •
0 (mm) 20 40 60 80 0 •
TRACE # 80 RMS 30.37861 P-V 460.5441


CYLINDRICAL MIRROR : MULTITRACE MEASUREMENT / WAVEFRONT FUNCTION
I 1800 °
26
46
66
86
RMS 275.4231 P-V 2648.377
2880 °
2160 °
1440 °
720 °
0 °
0 (mm)
20
40
60
80
TRACE # 85 RMS 40.37565 P-V 616.2419


CYLINDRICAL MIRROR : MULTITRACE MEASUREMENT / WAVEFRONT FUNCTION
I 1800 •
26
46
66
86
RMS 275.4231 P-V 2648.377
2880 •
2160 •
1440 •
720 •
0 (mm) 20 40 60 80 0 •
TRACE # 90 RMS 53.98688 P-V 837.9254


CYLINDRICAL MIRROR : MULTITRACE MEASUREMENT / WAVEFRONT FUNCTION
I 1800 °
26
46
66
86
RMS 275.4231 P-V 2648.377
2880 °
2160 °
1440 °
720 °
0 °
0 (mm)
20
40
60
80
TRACE # 95
RMS 71.74483 P-V 1138.347


CYLINDRICAL MIRROR : MULTITRACE MEASUREMENT / WAVEFRONT FUNCTION
I 1800 •
26
46
66
86
RMS 275.4231 P-V 2648.377
2880 •
2160 •
1440 •
720 •
0 (mm) 20 40 60 80 0 •
TRACE # 98 RMS 84.04984 P-V 1357.277