108

SCANNING SYSTEM FOR DETERMINATION OF OPTICAL DEFECTS

P. K. Saunders

ENGINEERING DIVISION

OCTOBER - DECEMBER 1971

Normal Process Development
Endeavor No. 231

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

MASTER

Mason & Hanger-Silas Mason Co., Inc.

Pantex Plant

P. O. BOX 647
AMARILLO, TEXAS 79105
806-335-1581

operated for the
ATOMIC ENERGY COMMISSION
under

U. S. GOVERNMENT Contract DA-11-173-AMC-487 (A)

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

SCANNING SYSTEM FOR DETERMINATION OF OPTICAL DEFECTS

P. K. Saunders

ENGINEERING DIVISION

A laser, photodiode detector and two positioning fixtures comprise a system for testing mirrors and machined lenses for optical defects.

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

October - December 1971
Endeavor No. 231
Acct. No. 22-2-24-15-300

Section EE

SCANNING SYSTEM FOR DETERMINATION OF OPTICAL DEFECTS

ABSTRACT

A method for determining percent of light transmission through a machined lucite lens and a first surface mirror is described.

DISCUSSION

The sight plate in the Hedgehog test fire buildup is a lucite lens machined on a lathe. The lens is polished after machining but lathe grooves are still visible after this polishing. As a light ray passes through the lens, these grooves cause the light to be refracted from its nominal path. A laser beam directed through the lens onto a photodiode detector is used as a method for determining percent light transmission. The photo current of the photodiode is directly proportional to the light intensity striking the photodiode's active area. Any imperfections in the lens surface refract the laser beam away from the photodiode's 5.1 square mm active area.

The measuring system includes a laser, neutral density filter, and a sight plate scanning fixture all mounted on an optical rail as shown in Fig. 1. The sight plate scanning fixture is designed such that the lens and diode detector rotate independently about the same vertical axis with an angle readout on each pivot arm. In the initial setup the laser beam is directed through the center of the lens onto the diode detector with both angle readouts indicating 0°. The lens is rotated in 5° increments, and the detector is adjusted for a maximum reading at each position. The detector reading and detector angle are both recorded, giving 14 readings across the face of the lens. The lens is then rotated 90° in the fixture and 14 more readings are taken. These readings are then compiled to give a radial composite view of the optical transmission characteristics of the lens. The computation involves calculating the mean of four readings at each 5° increment level. The program of Table I for the H.P. 9100A calculator automatically calculates the mean, prints out each mean, and plots the curve for each lens. Fig. 2 shows the calculator's automatic plot of six different sight plate lenses illustrating the ability of the system to detect imperfections in a lens. The use of this system will assure that only consistent quality lenses are used in test fire procedures.

Two first surface mirrors are used in each Hedgehog test fire to position the light from the test fire onto the high speed cameras in the bunkers. Since there is a marginal quantity of light available for the cameras, losses from optical defects must be kept to a minimum. A laser beam reflected off the first surface mirrors onto a photodiode detector is used to determine defects in the mirrors. Imperfections in the mirror surface cause divergence or scattering of the beam and a corresponding drop in the detector reading. Using a mirror scanning fixture designed by Tooling, six mirrors were scanned and the percent reflectivity determined. The average for the six mirrors is 88.4% with a range of 3.3%, representing excellent quality.

Fig. 1a. Sight Plate Scanning Fixture

Fig. 1b. Mirror Scanning Fixture

Fig. 2. Sight Plate Lens Light Transmission vs. Angle

Table I. Program for H.P. 9100A Calculator, Printer, Plotter

Clear	MLT
0	a
X→( )	FMT
a	↓
Clear	5
Stop	0
↑	0
Stop	↑
+	a
Stop	+
+	↓
Stop	X→( )
+	a
4	Go To
÷	0
Print	4
Print	End
2	
0	

CONCLUSIONS

The laser-photodiode, detection system is capable of accurately determining transmissivity through a lens or reflectivity of a mirror. The mirrors were all good quality with little variation between pieces. This system would reject many of the sight plate lenses now being used and assure the quality of ones that pass the test.