

FIBER OPTIC TRAINER

EXPERIMENT 7 MEASUREMENT OF NUMERICAL APERTURE

Objective :

The theory of this experiment is to measure to the Numerical Aperture (NA) of the fiber.

Theory :

Numerical aperture refers to the maximum angle at which the light incident on the fiber end is totally internally reflected and is transmitted properly along the fiber. The cone formed by the rotation of this angle along the axis of the fiber is the cone of acceptance of the fiber. The light ray should strike the fiber end within its cone of acceptance else it is refracted out of the fiber.

Consideration in NA Measurement :

1. It is very important that the optical source should be properly aligned with the cable and the distance from the launched point and cable be properly selected to ensure that the maximum amount of optical power is transferred to the cable.

Equipment :

1. Numerical aperture measurement jig.

Procedure :

1. Connect power supply to the board.
2. Connect the frequency generator's 1KHz sine wave output to input of emitter circuit. Adjust the amplitude at 5V p-p.
3. Connect one end of fiber cable to the output socket of emitter circuit and the other end to the numerical aperture measurement jig. Hold the white screen facing the fiber such that its cut face is perpendicular to the axis of the fiber.
4. Hold the white screen with 4 concentric circles (10, 15, 20 & 25 mm diameter) vertically at a suitable distance to make the red spot from the fiber coincided with 10mm circle.

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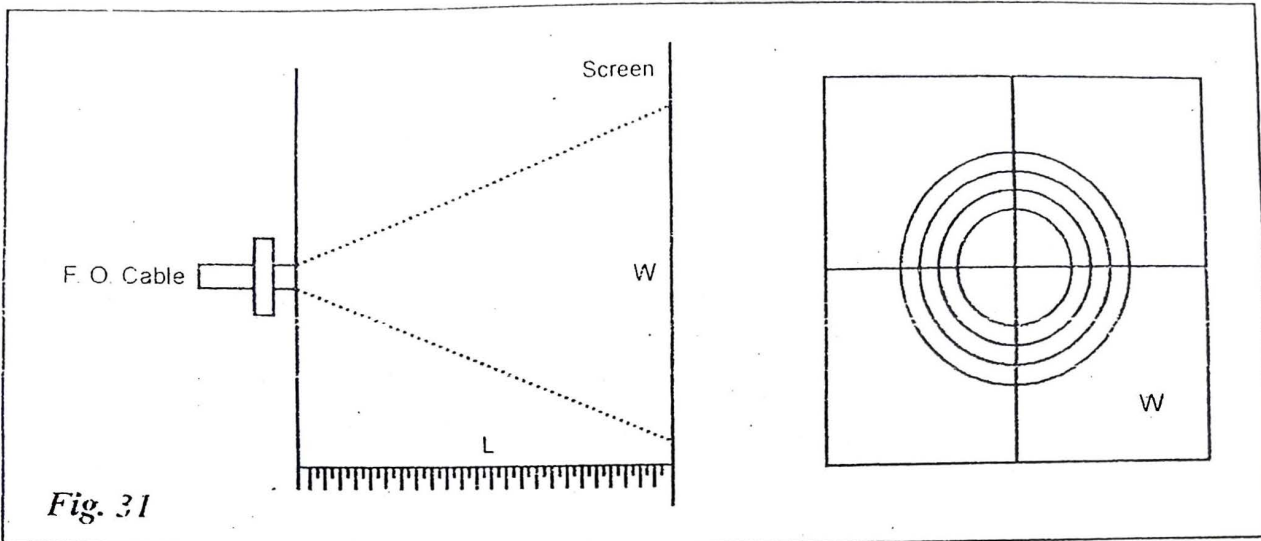


Fig. 31

5. Record the distances of screen from the fiber end L and note the diameter W of the spot.
6. Compute the numerical aperture from the formula given below :

$$\begin{aligned}
 \text{NA} &= \frac{W}{\sqrt{4L^2 + W^2}} \\
 &= \sin \theta_{\max} \text{ (acceptance angle)}
 \end{aligned}$$

7. Vary the distance between in screen and fiber optic cable and make it coincide with one of the concentric circles. Note its distance.
8. Tabulate the various distances and diameter of the circles made on the white screen and computes the numerical aperture from the formula given above.

Inferences :

The NA recorded in the manufacturer's data sheet is 0.5 typical. The variation in the observation is due to fiber optic being under filled. The acceptance angle is given by θ_{\max} . The deviation from the data sheet is again due to fiber being under filled.

Table :

Voltage	Output Power Meter dB

TO NUMERICAL OPERATING JIG

FUNCTION GENERATOR

SW1: OFF ON
10Hz
100Hz
1KHz
10KHz

SQUARE

SINE

FREQUENCY ADJ. P1

AMPLITUDE ADJ. P2

SW2

DIGITAL LINK

ANALOG LINK

IN

OUT

FO TRANSMITTER

IN

OUT

FO RECEIVER

P3

AC AMPLIFIER

LOW PASS FILTER

P4

AUDIO IN

MIC IN

AUDIO INPUT

GROUND

RTS1 CTS2

CTS1 RTS2

SW3

TD1 RD1 RD2 TD2

RS-232 TRANS RECEIVER

RS-232 TRANS RECEIVER

CN1

CN2

PC TO PC COMMUNICATION

P5

IN

OUT

COMPARATOR

GROUND

1 2 3

JP1

AUDIO OUT

SPEAKER OUT

AUDIO OUTPUT

FIBER OPTIC TRAINER

ACT-12

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