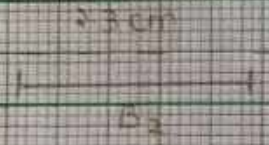

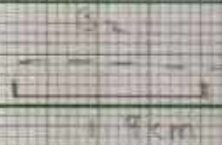

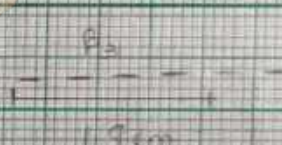

Aim: To find the width of the wire using diffraction pattern obtained by an He-Ne laser.

Apparatus:

Optical Bench, an upright holding wire, samples of 3 different wires, a metre scale, an He-Ne laser

Theory:

When a monochromatic light diffract around a fine wire ~~(whose thickness is same)~~ a diffraction pattern is observed at the screen placed on the other side of the wire. The pattern consists of dark and bright fringes. The central bright fringe is very intense and successive bright fringes are less intense. These fringes are of equal width and the fringe width is given by $\beta = \frac{D\lambda}{d} \Rightarrow d = \frac{D\lambda}{\beta}$

where d = thickness of the wire

D = distance between screen & wire

λ = wavelength of the He-Ne laser or source.

As the thickness d of the wire increases, the width of the fringes decreases $\left(\beta \propto \frac{1}{d}\right)$

OBSERVATIONS:

S No	Distance b/w object (D) and image (cm)	Fringe width (β) (cm)	Diameter of wire (cm) d	Diameter of wire by screw gauge (cm)
1.	75.5	0.575	0.149×10^{-1}	0.14×10^{-1}
2.	136.2	1	0.086×10^{-1}	0.087×10^{-1}
3.	131	0.48125	0.18×10^{-1}	0.2×10^{-1}
4	143.4	0.85625	0.106×10^{-1}	0.092×10^{-1}

Screw Gauge calculations Least count = 0.005 mm

(a) MSR = 0, CSR = 28

Reading 1 = $28 \times 0.005 = 0.14$ mm $R_2 = 0.145$ mm, $R_3 = 0.14$ mm

Mean reading = $(0.14 + 0.145 + 0.14)/3 = 0.141667 \approx 0.14$ mm

(b) MSR = 0, CSR = ~~23~~ 17

Reading 1 = ~~23~~ 17 $\times 0.005 = 0.085$ mm, $R_2 = 0.085$ mm, $R_3 = 0.09$ mm

Mean Reading = $(0.085 + 0.085 + 0.09)/3 = 0.08667 \approx 0.087$ mm

(c) MSR = 0, CSR = 40

Reading 1 = $40 \times 0.005 = 0.2$ mm, $R_2 = 0.2$ mm, $R_3 = 0.2$ mm

Mean Reading = $(0.2 + 0.2 + 0.2)/3 = 0.2$ mm

(d) Hair: MSR = 0, CSR = 18

Reading 1: $18 \times 0.005 = 0.09$ mm, $R_2 = 0.09$ mm, $R_3 = 0.095$ mm

Mean Reading = $(0.09 + 0.09 + 0.095)/3 = 0.091667$

≈ 0.092 mm

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Calculations:

1. D_1 = distance b/w object & Image = 755 cm, $\lambda = 632.8 \times 10^{-7}$ cm

$4B_1 = 2.3$ cm $\Rightarrow B = \frac{2.3}{4} = 0.575$ cm

$d = \frac{\lambda D_1}{B_1} = \frac{632.8 \times 10^{-7} \text{ cm} \times 75.5 \text{ cm}}{0.575 \text{ cm}} = 0.144$ mm

2. $D_2 = 136.2$ cm, $\lambda = 632.8 \times 10^{-7}$ cm

$4B_2 = 4$ cm $\Rightarrow B_2 = 1$ cm

$d = \frac{\lambda D_2}{B_2} = \frac{632.8 \times 10^{-7} \times 136.2}{1} = 0.086$ mm

3. $D_3 = 131$ cm, $\lambda = 632.8 \times 10^{-7}$ cm

$4B_3 = 1.925$ cm $\Rightarrow B_3 = \frac{1.925}{4} = 0.48125$ cm

$d = 0.18$ mm

4. $D_4 = 143.9$ cm, $\lambda = 632.8 \times 10^{-7}$ cm

$4B_4 = 3.425$ cm $\Rightarrow B_4 = 0.85625$ cm

$d = \frac{\lambda D_4}{B_4} = \frac{632.8 \times 10^{-7} \text{ cm} \times 143.9 \text{ cm}}{0.85625} = 0.0106$ mm

Precautions and Sources of Error:

1. Laser beam should be horizontal & not tilted.
2. Laser beam should not be looked upon directly with the naked eye.
3. Once a sharp diffraction pattern is achieved, the set up should not be disturbed.
4. The screen should be kept normal to the incident beam.

Result:

The measured and actual diameters of the wire are nearly equal