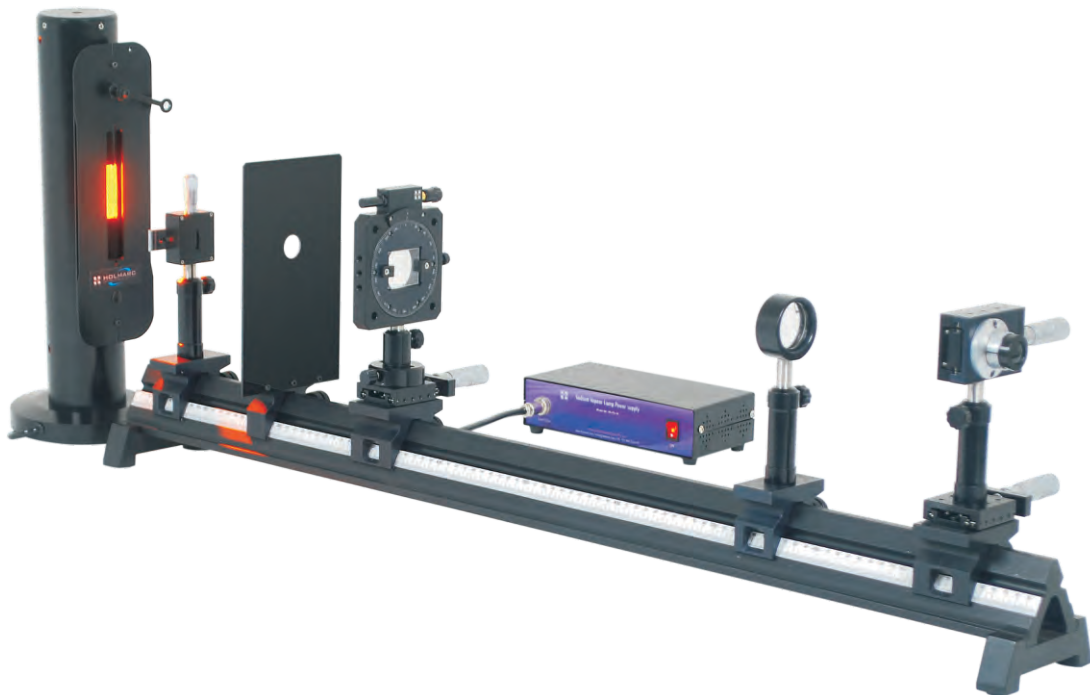




Instruction Manual



Biprism Diffraction Apparatus

Model: HO-ED-D-07

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Product Features

HOLMARC's model no : **HO – ED – D – 07** Fesnal's Bi – prism apparatus is an educational instrument, which demonstrates interference and diffraction together using a bi prism illuminated by a monochromatic light. The apparatus consists of an optical rail on which the components can be mounted with the help of posts, post holders and rail carriers. All the components can be fixed on particular positions as well as moved over the rail as required for the experiment. The required optical components as well as the monochromatic light source, the sodium vapour lamp is also provided with the experimental kit.

Getting Started

a. Quick Start Guide

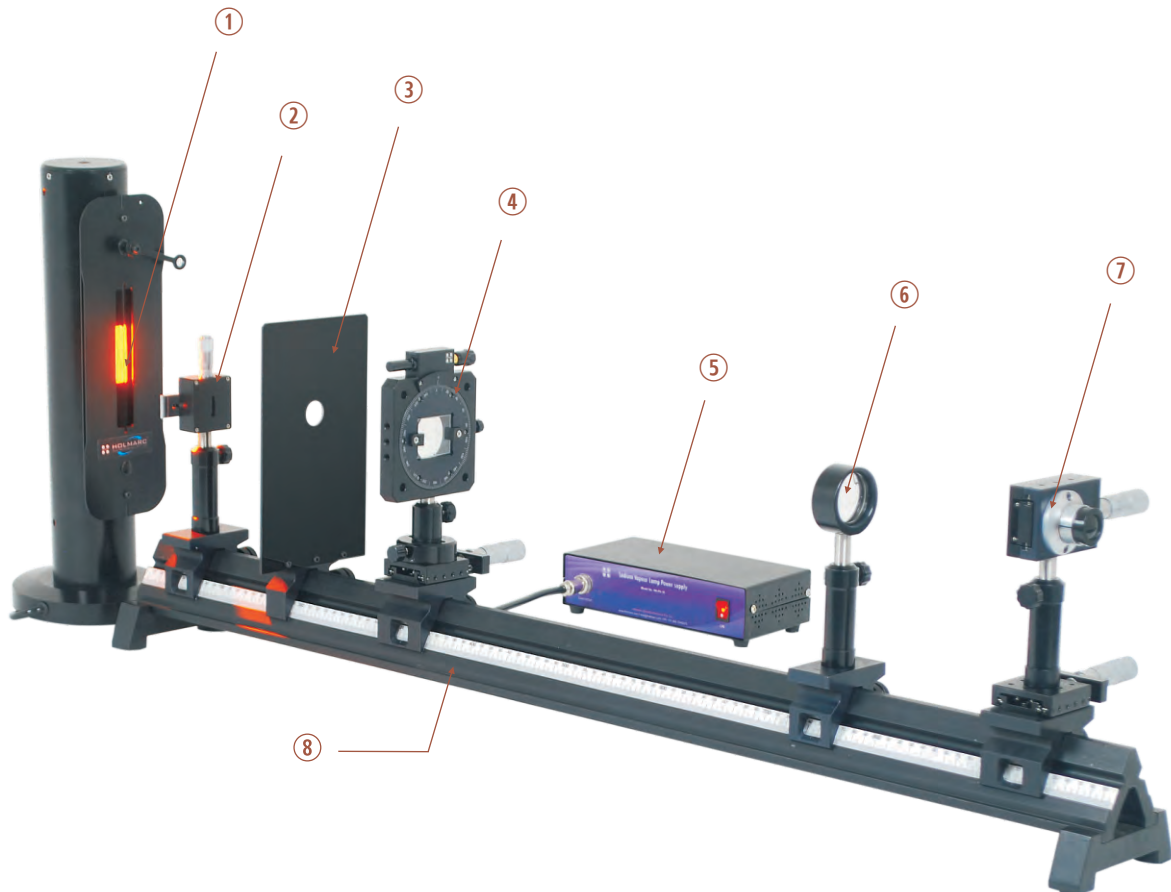
Please check if the following items are present while the instrument package is delivered.

1. Optical Rail (1300 mm)	1 No.
2. Slit with mount	1 No.
3. Black screen with mount	1 No.
4. Bi – prism mount with micrometers	1 No.
5. Bi – prism	1 No.
6. Eye – piece with micrometer drive	1 No.
7. Achromatic Lens with mount	1 No.
8. Sodium vapour lamp with power supply	1 No.
9. Instruction manual	1 No.

b. Safety and Installation instructions

- Carefully handle the optical components such as eyepiece, achromatic lens, and bi-prism.
- Do not hold your fingers on the main optical surfaces, hold them by edge.
- Always keep the equipment in a moist and dust free atmosphere.
- Try to do the experiment in a dark room for better and accurate results.

c. Parts Listing



1. Sodium vapour Lamp
2. Slit with mount
3. Screen with mount
4. Bi – prism with mount
5. Sodium vapour lamp power supply
6. Achromatic lens with mount
7. Eye – piece with mount
8. Optical Rail

Components And Specifications

1. Optical Rail

Length 1500 mm
Material Black Anodized Aluminium



2. Slit with mount

Slit size 0 – 3 mm
Micrometer controllable,
micrometer least count 0.01 mm



3. Black Screen with circular aperture

Material Acrylic
Size 210 x 120x 3 mm



4. Bi-prism with rotatable mount

Dial movement

Coarse movement 360°

Fine movement 10°

Micrometer resolution 0.01 mm for both micrometers



5. Eye-piece with Micrometer

Magnification 10 X

Micrometer least count 0.01 mm



6. Achromatic Lens with Mount

Diameter 40 mm

Focal length 202 mm



7. Sodium Vapor Lamp with lamp house and Power Supply

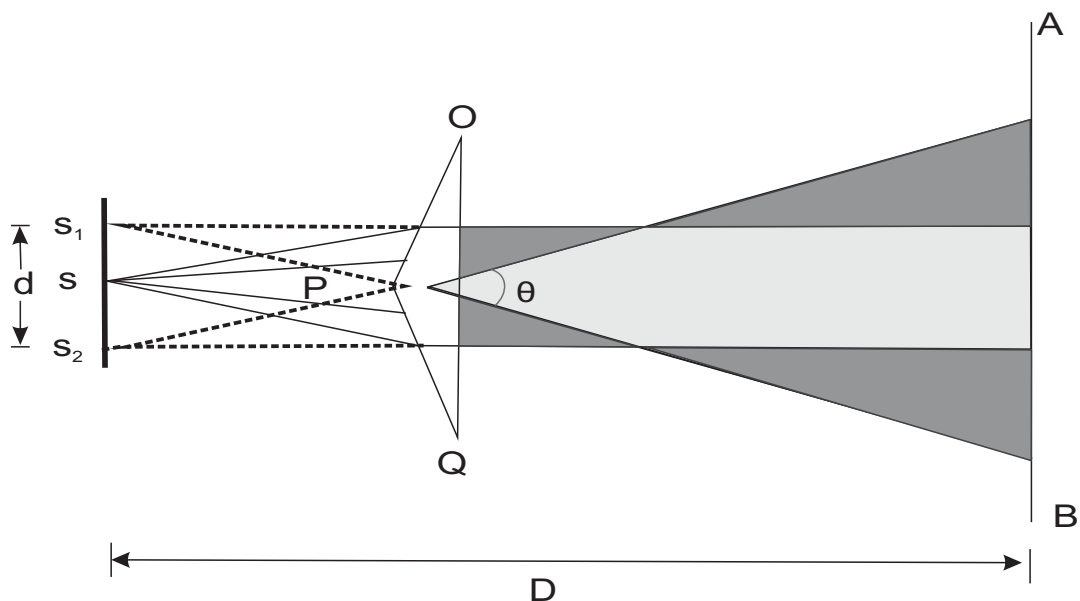
Power 35 W



Introduction

The properties of light were an unaware subject until Huygen interpreted its wave nature, later the particle nature of it came out. Phenomenon such as reflection, refraction, interference, diffraction and polarization are ready to explain the wave nature of light. But reflection and refraction also give a glimpse of the particle nature. Therefore the wave nature of light can be studied easily through the phenomenon called interference and diffraction. Diffraction explains the bending of light waves around small obstacles with size comparable to the wavelength of light where as interference explains the combination of waves with similar properties, or the combination of waves from two coherent sources arising due to division of wave fronts and division of amplitudes. Various systems based on these principles have been designed and are used to observe it. These systems find several applications in science and engineering such as measurement of wavelength of a light source, the wavelength difference between two closely separated waves, the optical flatness of surfaces, thickness of the film, refractive index of material etc. We can make use of both interference and diffraction to characterize different frequencies.

Fresnel's bi prism method is one of the easiest and earliest methods used to demonstrate interference between two coherent light beams obtained from the diffraction a single monochromatic light source. The Fresnel bi - prism is a double prism placed base to base and have very small refracting angle approximately equal to $30'$. This is equivalent to a single prism with one of its angle nearly 179° and other two of $= 30'$ each. The beams diffracted from this common base superimpose and exhibit interference.



When monochromatic light through a single slit, s falls on bi-prism OPQ it gets divided into two components, one refracted from the portion OP and the other from PQ, acts like two coherent virtual sources s_1 and s_2 .

The light waves from these two sources interfere in between and produces interference pattern on a screen, AB placed with its plane perpendicular to the plane containing slit and the bi – prism. If d is the distance between two virtual sources, D is the distance between slit and eyepiece and λ is the wavelength of the monochromatic light, then the fringe width, β , the distance between two consecutive dark or bright fringes is given by,

$$\beta = \lambda D / d$$

Then the wavelength is given by,

$$\lambda = \beta d / D$$

The source separation, d can be found out using Lens conjugate foci method, since both the sources are virtual. Introduce a convex lens of short focal length in between bi – prism and eyepiece. Then without disturbing the positions of both slit and bi – prism move the eyepiece, so that its distance from the slit becomes 4 times the focal length of the lens. Move, lens towards the slit and its position L_1 is adjusted so that it magnifies s_1 and s_2 to form two images A_1 and B_1 in the focal plane of eyepiece. Measure the distance d_1 between A_1 and B_1 .

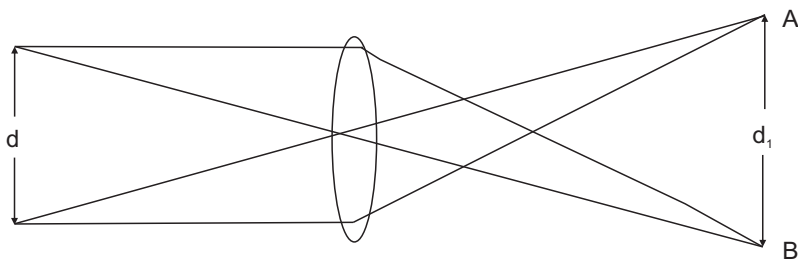
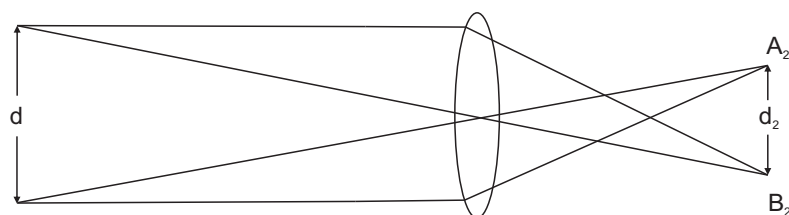


Fig. 1

Fig. 2



From the figure (1) we can write that,

$$d_1 / d = v / u \dots\dots\dots (3)$$

(v = distance of image, u = distance of object)

In figure 2 we have moved the lens towards the eyepiece at L_2 and we obtain a diminished image of the two virtual sources, A_2 and B_2 of s_1 and s_2 in the focal plane of the eyepiece. Measure d_2 between A_2 and B_2 by the principle of conjugate foci,

$$d_2 / d = u / v \dots\dots\dots (4)$$

Taking product of equations (3) and (4)

$$d_1 d_2 / d^2 = 1$$

$$d^2 = d_1 d_2,$$

$$d = \sqrt{d_1 d_2}$$

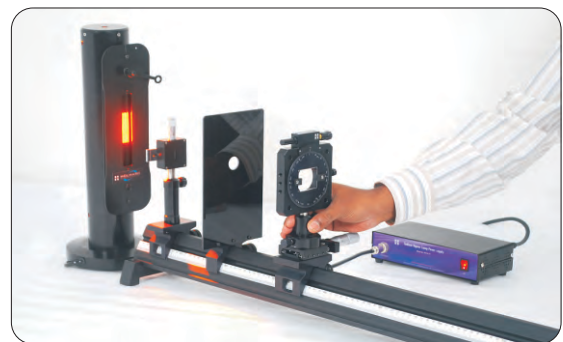
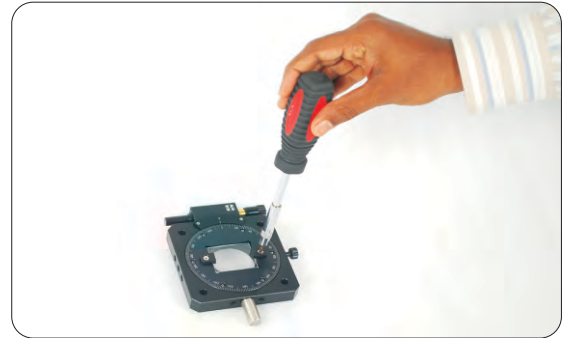
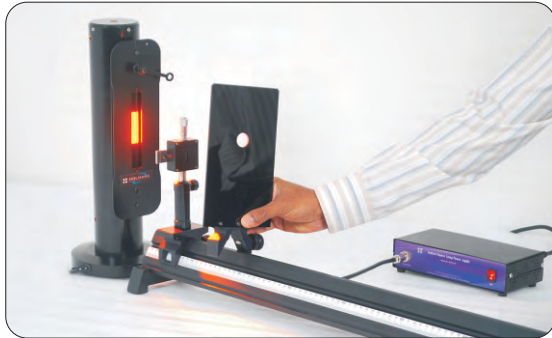
Therefore by measuring ‘ D ’ and calculating, ‘ d ’ and ‘ β ’ we can obtain the wavelength of the monochromatic light.

❖ Experimental Set-up And Procedures

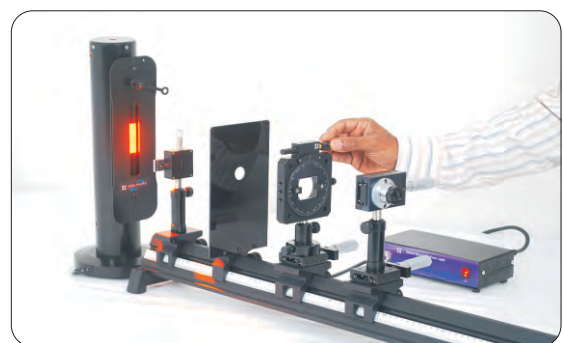
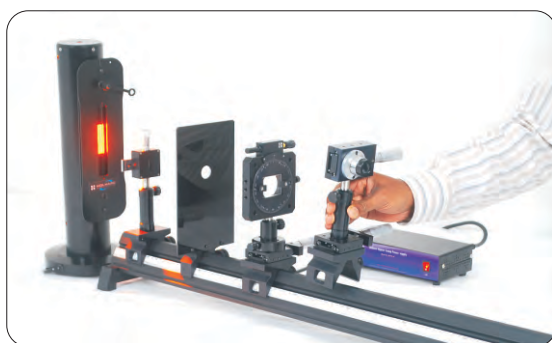
1. Connect the sodium vapour lamp to the power supply and switch it on and let it produce a stabilized light. Mount the width adjustable slit on the rail so that it is exactly in front of the glowing sodium lamp.



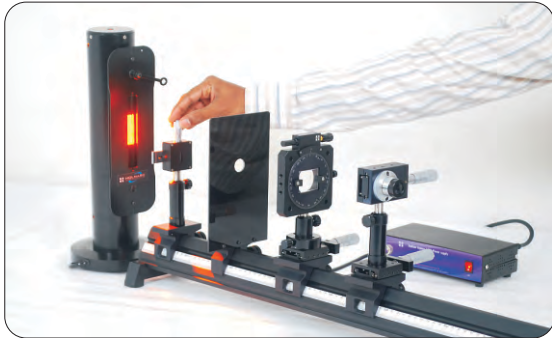
2. Now fix the screen with circular aperture near to the slit so that the slit is clearly visible through the circular aperture. Fix bi prism on the mount and fix it on the rail with the help of a holder with translational stage.



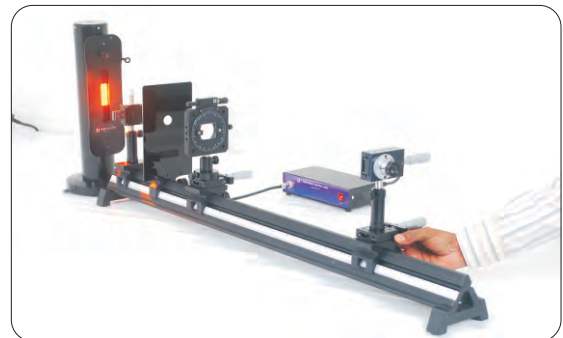
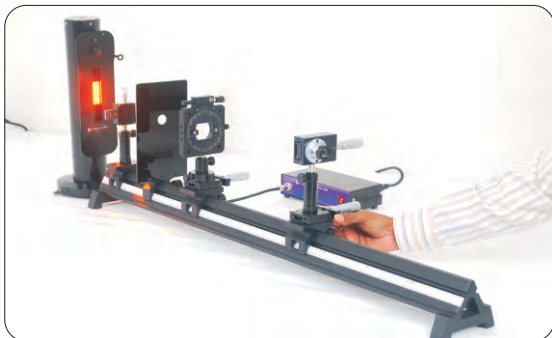
3. Then mount the eye piece with micrometer translation next to the bi prism mount. Make sure that all the components are aligned at the same height. Bring eye piece close to the bi prism, as you look through the eye piece you will see a vertical patch of light (if the slit and bi prism vertex are not parallel to each other). Make coarse movement of the rotating mount of the bi prism (by unlocking the grub screw attached with it), to make the slit and bi prism vertex parallel to each other. Whenever it becomes coplanar the vertical patch of light transforms into vertical equidistant fringes.



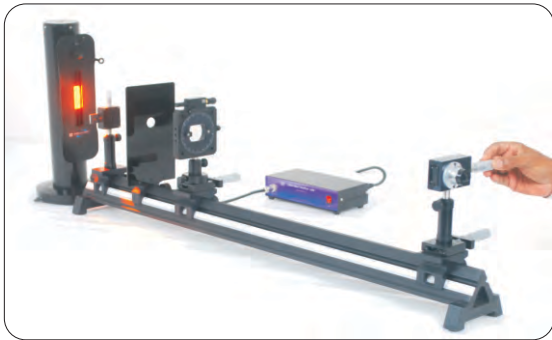
4. Also adjust the position of source and slit width to get the best compromise between brightness and sharpness of the fringe pattern. Fine adjust bi prism angle using the micrometer drive along with the mount (use it only after locking the coarse movement) until we get a perfectly distinct and well defined interference fringes.



5. Keeping the fringe pattern in the field of view, move the eyepiece slowly away from the bi prism mount along the optical rail to a distance of about 100 cm or more. Remember that you must have a bright and sharp image at the end.



Now start the experiment, observe how many fringes can be viewed at a time by moving the cross wire (using the micrometer) from one end to the other.



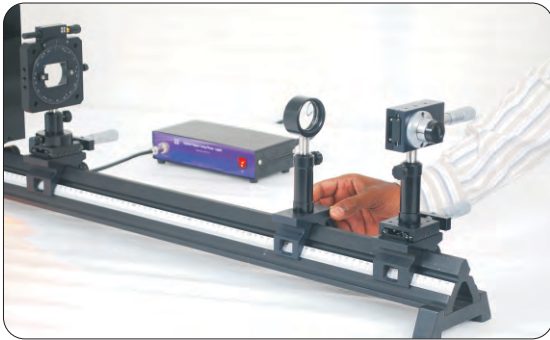
Keeping the cross wire on the centre of a bright (or dark) fringe at one of the end measure the distance traversed by the cross wire to cross an 'n' number of fringes (say 20). Note the initial and final reading of the micrometer to measure the same. If you have a large number of fringes in field of view repeat the measurement by keeping 'n' constant. If 'R' is the distance traversed by the crosswire to cross 'n' fringes,

Then,

$$\beta = R / n$$

Now it is the time to measure, 'd', interpose a convex lens between the bi prism and eyepiece making sure that $D > 4f$ (f = focal length of the of the lens).

(You must not disturb the position of slit, bi prism and eyepiece after the measurement of β so you must decide a D value, in the initial stage itself which is greater than $4f$).



Move the lens along the optical rail until you obtain two conjugate positions of the lens at which you can see real images of double slit in the field of view of the eyepiece.

At position L_1 near the bi prism you will get a wide image of the double slit and at a position L_2 near the eye piece you get a diminished image of the same. Measure the distance between two slits using the micrometer (keep the cross wire at the middle of one bright fringe and measure the initial reading of the micrometer and then move it to the centre of the second fringe and measure the final reading of the micrometer) and note it as d_1 and d_2 respectively.

Calculate d from the obtained d_1 and d_2 values and there by obtain the wavelength of the monochromatic light.

Observations and calculations

1. Measurement of fringe width, β

Distance between slit and eye piece, $D = \dots\dots\dots mm$

Trial No.	Micrometer reading		Width for n fringes R (mm)	Fringe width $\beta = R / n$ (mm)
	Initial (mm)	Final (mm)		

Mean fringe width, $\beta = \dots\dots\dots mm$

2. Determination of d

	Micrometer reading for the first bright fringe A_1, A_2 (mm)	Micrometer reading for the second bright fringe B_1, B_2 (mm)	Difference $A_1 - B_1$ and $A_2 - B_2$ (mm)
Lens at Position L_1			$d_1 =$
Lens at Position L_2			$d_2 =$

Therefore, $d = \sqrt{d_1 d_2} = \dots\dots\dots mm$

3. Calculating wavelength

The wavelength of used monochromatic light,

$$\lambda = \frac{d}{D} \beta = \dots\dots\dots nm$$

Experimental example

Distance between slit and eyepiece, $D = 100 \text{ cm}$

Trial No.	Micrometer reading		Width for n fringes R (mm)	Fringe width $\beta = R / n$ (mm)
	Initial (mm)	Final (mm)		
1	5.5	12.5	7	0.35
2	10	17	7	0.35

Mean fringe width $\beta = \underline{\underline{0.35 \text{ mm}}}$

	Micrometer reading for the first bright fringe A_1, A_2 (mm)	Micrometer reading for the second bright fringe B_1, B_2 (mm)	Difference $A_1 - B_1$ and $A_2 - B_2$ (mm)
Lens at Position L_1	8	12.34	$d_1 = 4.34$
Lens at Position L_2	9	9.67	$d_2 = 0.67$

$$d = \sqrt{4.34 \times 0.67} = 1.705 \text{ mm}$$

$$\begin{aligned} \text{Therefore, } \lambda &= \beta d / D = (0.35 \times 10^{-3} \times 1.705 \times 10^{-3}) / 100 \times 10^{-2} \\ &= 596 \times 10^{-9} \text{ m} \\ &= 596 \text{ nm} \end{aligned}$$

Technical Support

Before you call the HOLMARC Technical Support staff, kindly gather the following information:

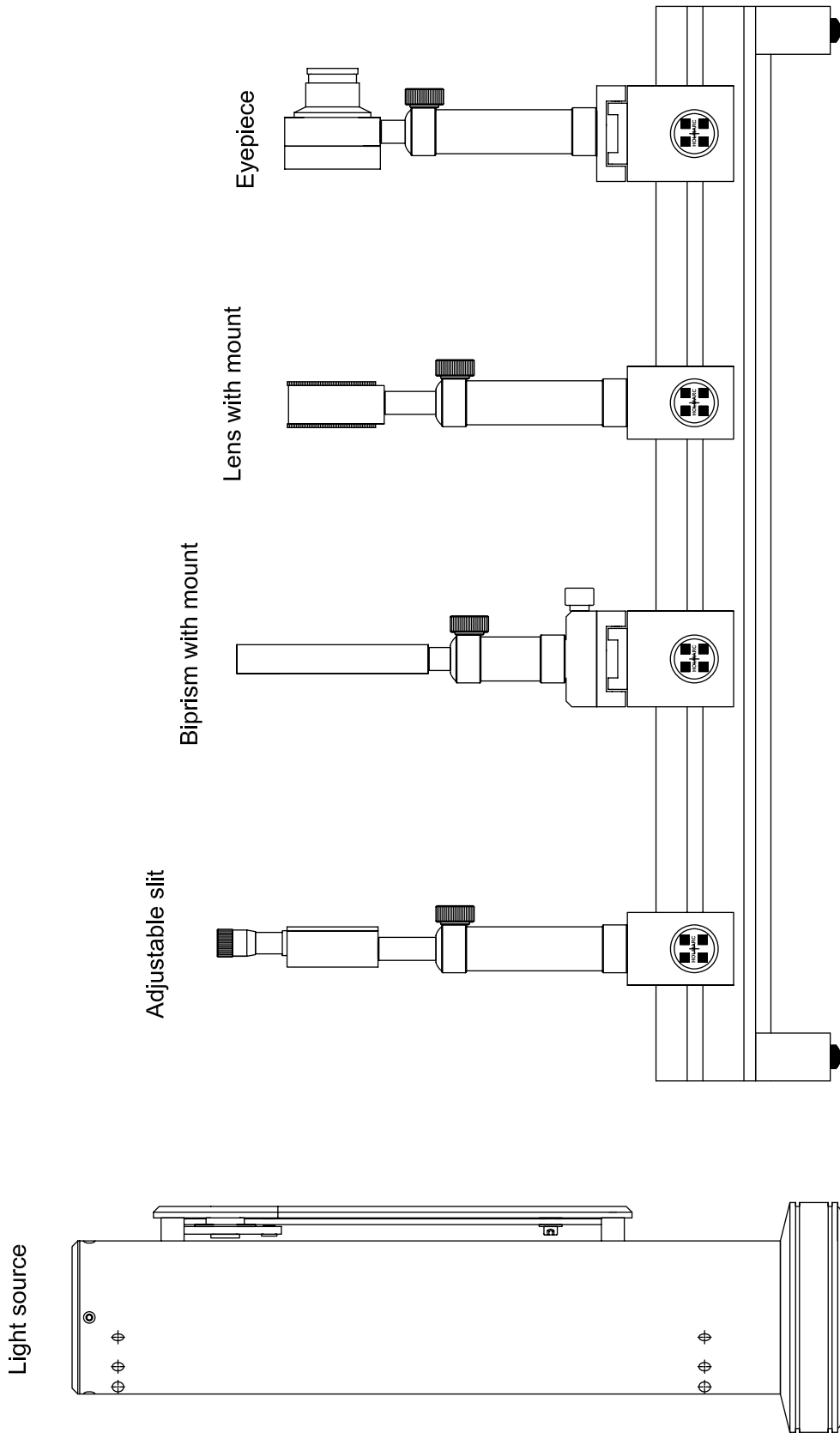
- Title and model number (usually listed on the label)
- Approximate age of apparatus
- Detailed description of the problem / sequence of events
- Have the manual in hand to discuss your query

Feedback

If you have any comments regarding our product or manual, please let us know. If you have any suggestions on alternate experiments or find a problem in the manual, kindly inform us. HOLMARC appreciates any customer feedback. Your inputs help us evaluate and improve our product.

For technical support, contact us at
E-mail: sales@holmarc.com
Web: www.holmarc.com

❑❑ Mechanical Drawing



Holmarc Limited Warranty

Every Holmarc Instruments and its accessories are warranted by HOLMARC OPTO-MECHATRONICS LTD for a period of ONE YEAR from the date of original purchase.

Holmarc will repair or replace a product, or part thereof, found by Holmarc to be defective, provided the defective part is returned to Holmarc, with proof of purchase.

This warranty applies to the original purchaser and our distributors and is non-transferable.

Each returned part or product must include a written statement detailing the nature of the claimed defect, as well as the end user's name, address, and phone number.

This warranty is not valid in cases where the product has been abused or mishandled, where unauthorized repairs have been attempted or performed, or where depreciation of the product is due to normal wear-and-tear.

Holmarc specifically disclaims special, indirect, or consequential damages or lost profit which may result from a breach of this warranty. Any implied warranties which cannot be disclaimed are hereby limited to a term of one year from the date of original retail purchase.

Holmarc reserves the right to change product specifications or to discontinue products without notice.

Please refer our [commercial invoice](#) for warranty claim.

Signatory)

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