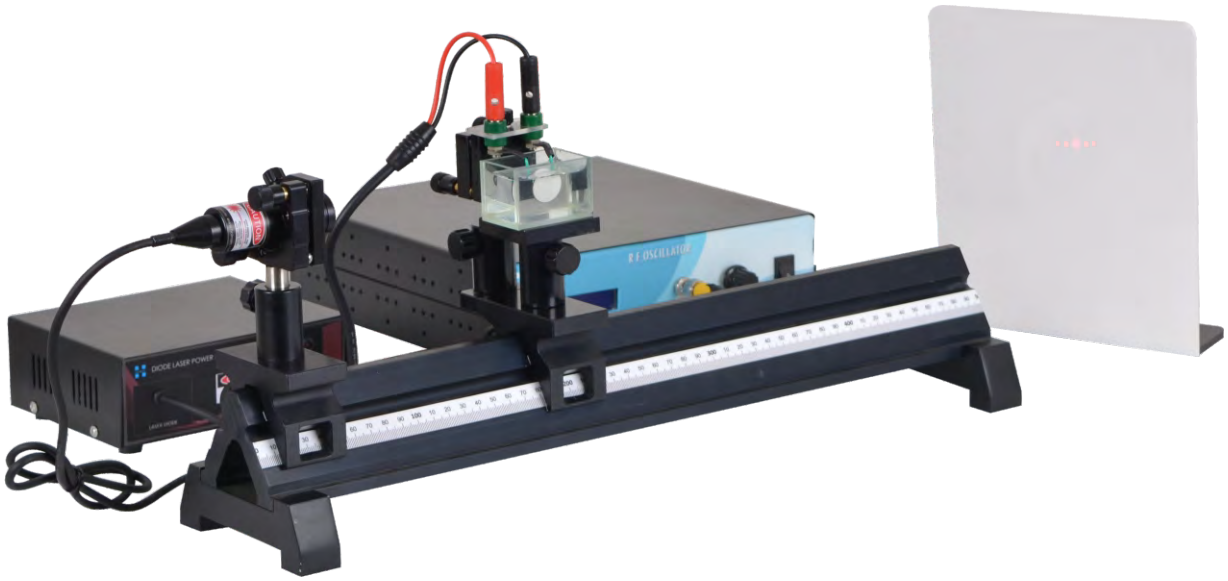
HOLMARC

Instruction Manual



Screen Based Apparatus For Ultrasonic Diffraction

Model: HO-ED-A-01A

CONTENT Page

Product Features

Ultrasonic diffraction apparatus is used to study the diffraction of light by ultrasonic waves. The apparatus consists of a graduated long rail and rail carriages appropriately fitted with laser head and glass tank holder with translation stage. The ultrasonic diffraction setup uses laser as light source. The pattern can be observed on a screen or a wall and we can plot diffraction pattern. We can perform the following experiments using this apparatus,

1. Determination of wavelength and velocity of ultrasonic wave in a liquid.
2. To find bulk modulus of the given liquid.
3. To find compressibility of the liquid.

Getting Started

a. Quick Start Guide

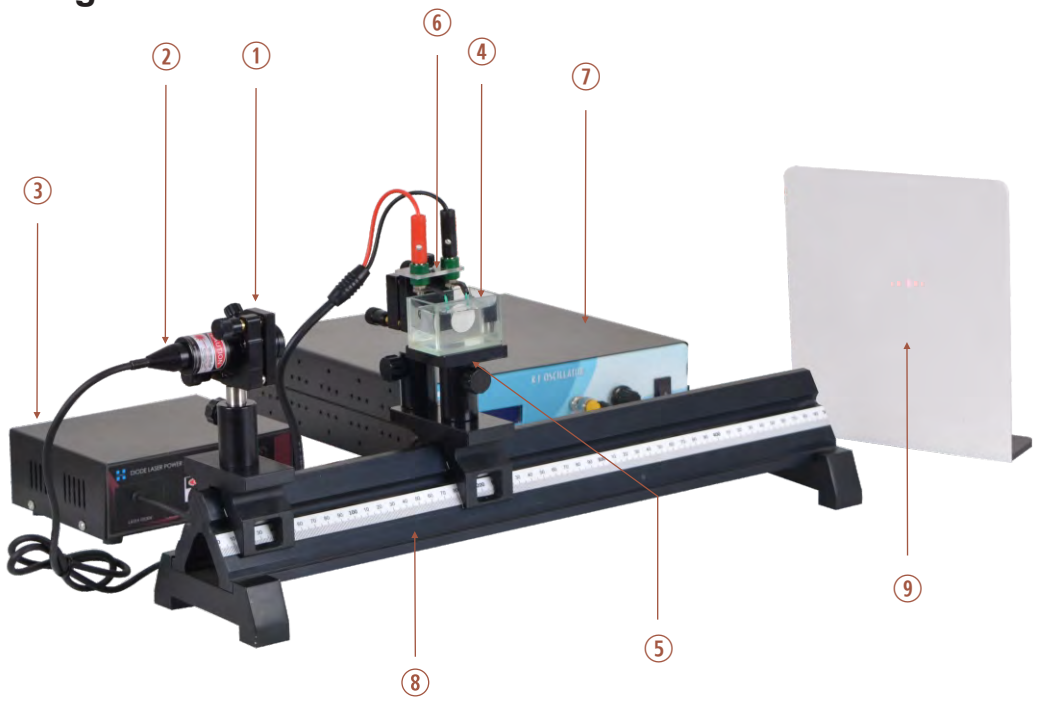
Please check if the following items are present when the instrument package is delivered.

1. Optical Rail(500mm) ..... 1 No
2. Kinematic Laser Mount ..... 1 No
3. Diode Laser with Power Supply ..... 1 No
4. Glass Tank ..... 2 Nos
5. Glass tank holder ..... 1 No
6. RF Oscillator ..... 1 No
7. Crystal with Mount
   a. 5 MHZ ..... 1 No
   b. 3 MHZ ..... 1 No
8. Screen ..... 1 No

b. Safety Instructions

- Laser radiation predominantly causes injury via thermal effects; avoid looking directly into the laser beam.
- Care should be taken while handling the crystal oscillator and other components.
- Remove the crystal from the liquid as soon as the experiment is completed. Otherwise the crystal may get damaged.

c. Part Listing



1. Kinematic Laser Mount
2. Diode Laser
3. Power Supply for Laser
4. Glass Tank With Liquid
5. Glass tank holder
6. Crystal with Mount
7. RF Oscillator
8. Optical Rail
9. Screen

Fundamentals

Aim :

1. To find the wavelength and velocity of ultrasonic wave in a liquid.
2. To find the bulk modulus of the given liquid.
3. To find the compressibility of the liquid

Theory :

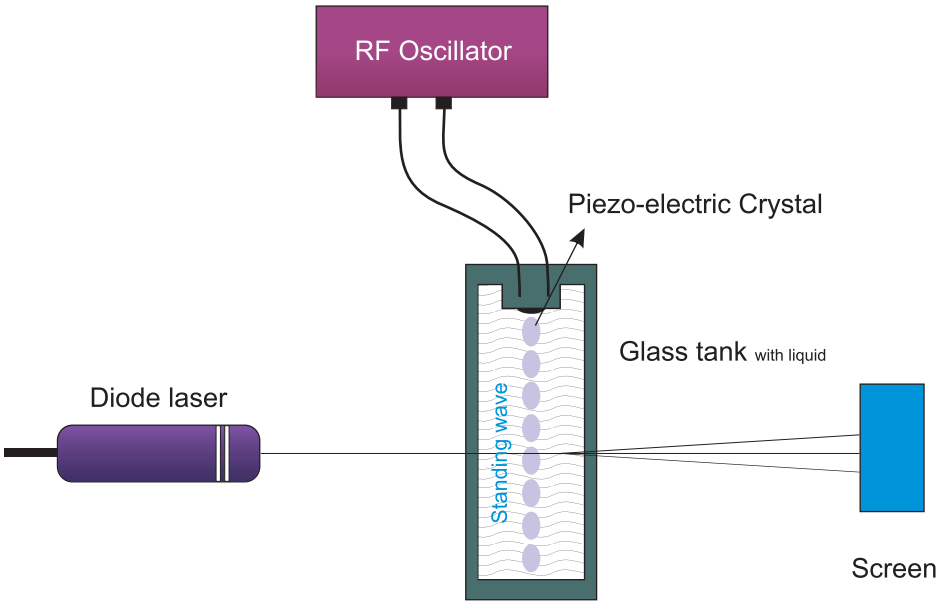


Fig. Optical system for observation of diffraction by ultrasonic waves

The ultrasonic waves generated by the transducer travels down the medium (liquid), gets reflected at the bottom (flat glass plate) of the cell. The incident and reflected waves interfere and stationery / standing waves pattern is formed. The velocity of ultrasonic waves in a liquid is calculated using the formula:

$$V = \upsilon \Lambda$$

where υ is the frequency of the crystal oscillator and Λ is the wavelength of waves.

We have $\Lambda = n \lambda / \text{Sin } \theta$

where n is the order of diffraction, λ is the wavelength of the laser (650nm) used and θ is the angle of diffraction.

We can find the angle of diffraction by the equation

$$\theta = \tan^{-1} (D / L)$$

D is the order length and L is the distance measured from the crystal oscillator to the detector.

The bulk modulus of the liquid

$$\beta = \rho V^2$$

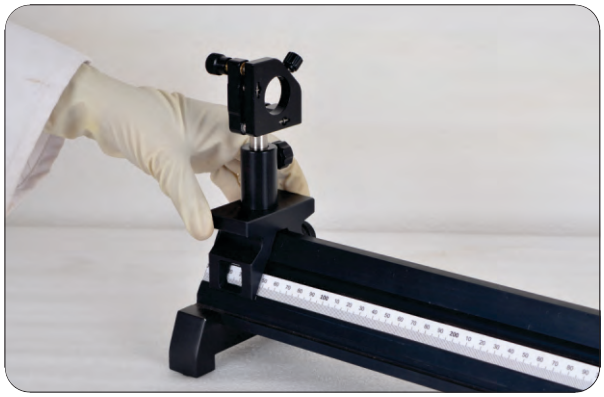
where ρ is the density of the liquid and V is the velocity of the ultrasonic wave.

The adiabatic compressibility of a liquid can also be calculated using the relation,

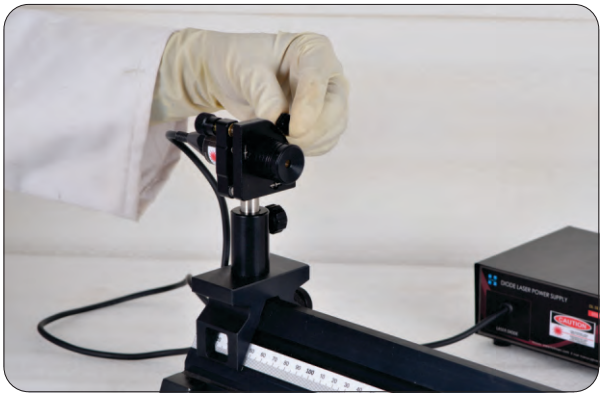
$$K = 1 / \rho V^2$$

Experimental Set-up

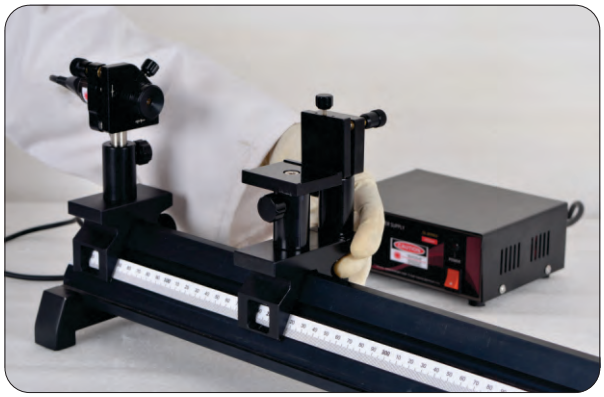
1. Fix the laser mount on optical rail.

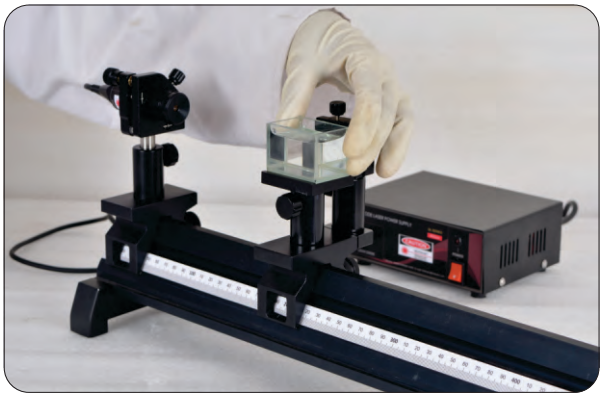


2. Place laser on the mount properly.

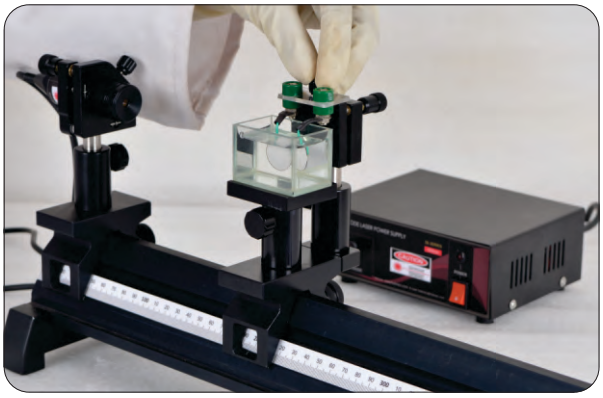


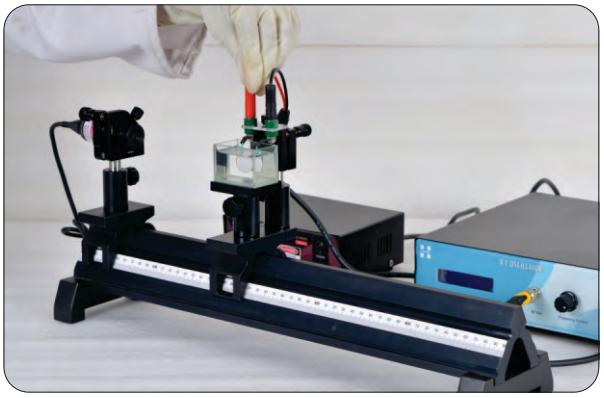
3. Place the glass tank holder on rail. Fill the glass tank with liquid and keep it on the tank holder.





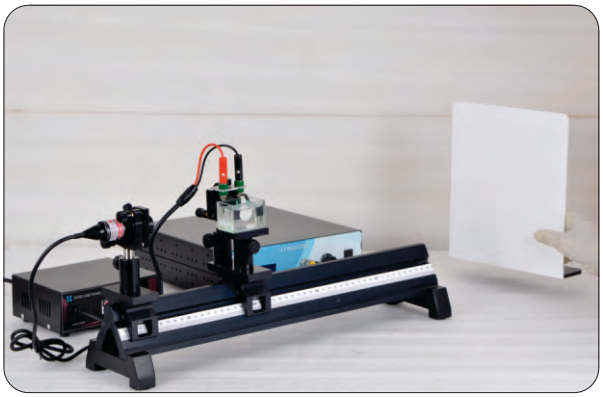
4. Fix the crystal on the mount and keep it immersed fully in the liquid. . Connect it to the RF oscillator.

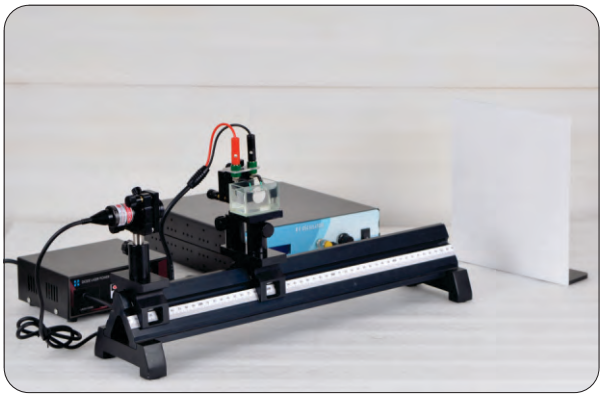




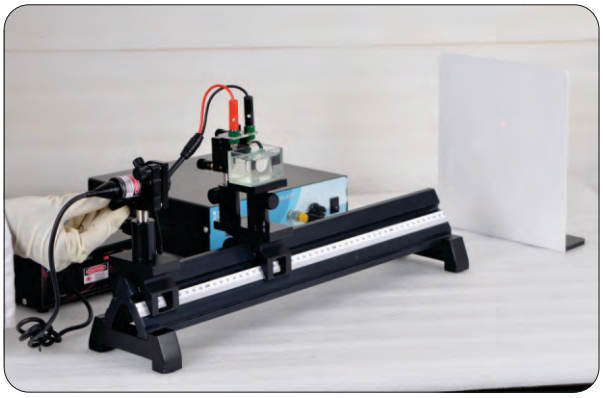
5. Place the screen in front of the glass tank at a particular distance.

NB:The distance from the glass tank to the screen should be at least 2.5meters for obtaining a clear pattern.



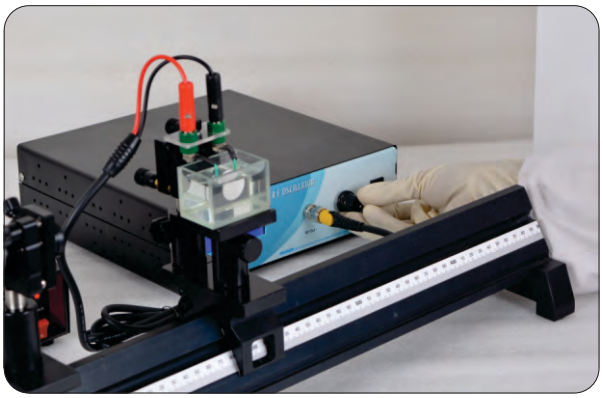


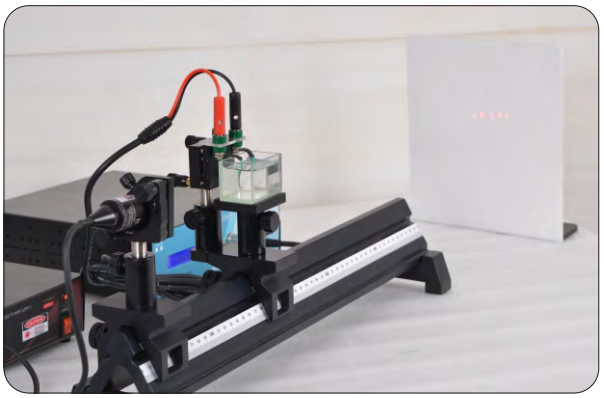
6. Switch on the laser and RF oscillator. Align the crystal and laser so that laser beam is parallel to the face of the crystal. Adjust the kinematic setup provided on the laser mount to get the beam in the field of standing wave generated.



Note: *Make sure that there are no air bubbles in the liquid especially around the crystal.*

7. Keep the laser spot falling on screen and adjust the frequency of the oscillator until you get a very good fringe pattern on both sides of the central bright spot.





8. Using a graph paper we can plot and measure the distance from the central bright spot to the n^{th} order spot.

Measurements

Wave length of the laser λ = 650 nm

Distance between the crystal and the detector, L = ……..m

Frequency of the crystal υ =……MHz

Observations:

Order n	Distance from the central spot to n^{th} order spot D (m)	Angle of ultrasonic diffraction $\theta = \tan^{-1}(D/L)$	$\Lambda = n\lambda / \sin\theta$ (m)	$V = \upsilon\Lambda$ (m/s)

Mean Wavelength = ... m

Mean velocity = …….m/s

The Bulk modulus $\beta = \rho V^2$ = ... Pa

The Compressibility $K = 1 / \rho V^2$ = ... Pa^{-1}

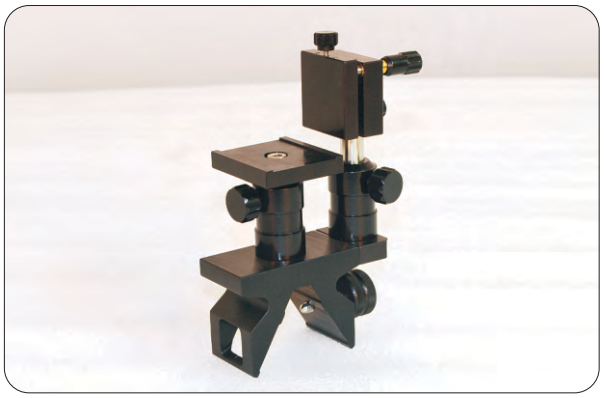
Items and Specifications

1. Optical Rail

Length 500mm
Material ..... Anodized Aluminum

2. Glass tank holder

Material ..... Anodized Aluminum



3. Kinamatic laser mount

Material ..... Anodized Aluminum
Adjustments ..... Using 80 tpi lead screws

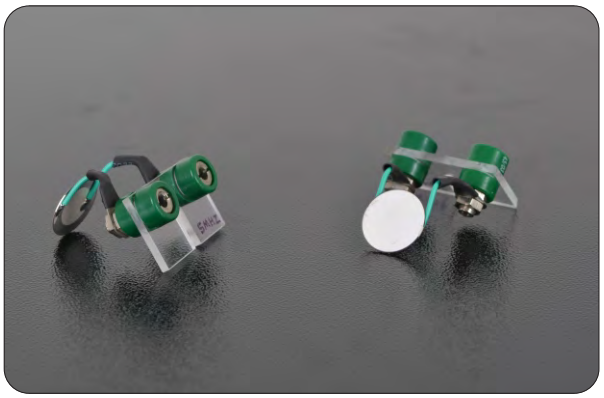
4. RF Oscillator

Frequency Range ..... 2MHz - 6MHz
Input ..... 230V / 50 Hz

5. Diode laser with Power Supply

Input ..... 230V AC / 50 Hz
Output power 3mW
Wavelength 650nm

6. Piezo Electric Ceramic Disc Transducer



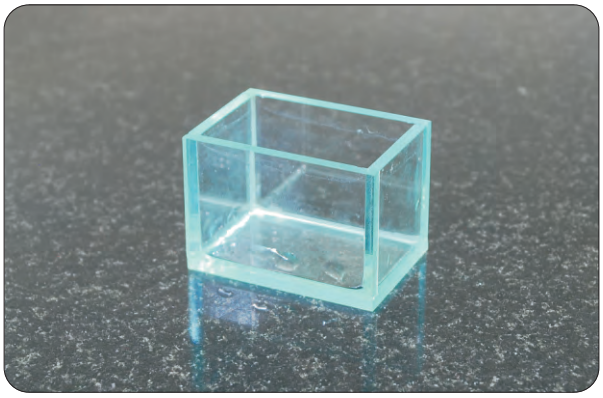
Dimension: 20mm diameter x 0.7mm thickness
Resonant frequency f_r: 3MHz ± 50 KHz
Resonant impedance Z_m: ≤ 6 Ω
Static capacitance C_s: 5700pF ± 15% @ 1 kHz

Dimension: 20mm diameter x 0.4mm thickness
Resonant frequency f_r: 5 MHz ± 100 KHz
Resonant impedance Z_m: ≤0.48 Ω
Static capacitance C_s: 3800pF ± 20% @ 60Hz/1V

7. Glass tank

Material : Float glass

Dimension : 50mm x 35mm x 35mm



8. Screen

Maintenance Notes

- Always keep the equipment in a moisture and dust free atmosphere.
- 'Switch on' all the electronic devices used in this experiment at least once a week.

Technical Support

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

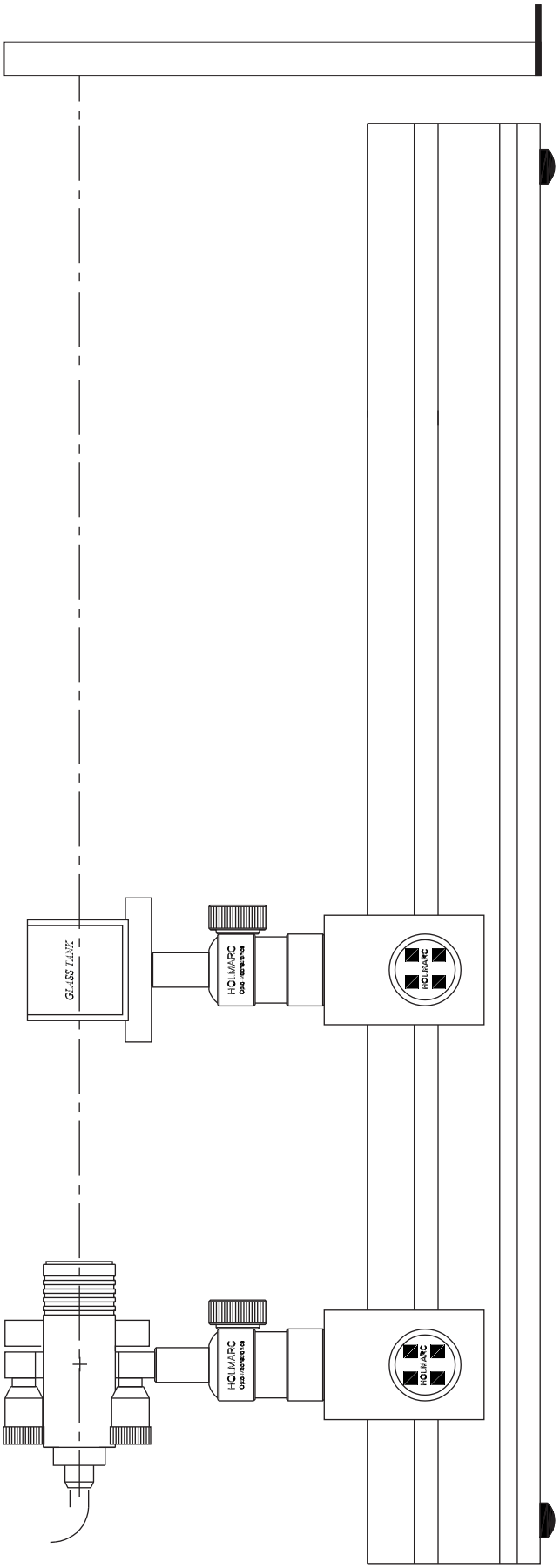
- Title and model number (usually listed on the label)
- Approximate age of apparatus
- Detailed description of the problem / sequence of events
- Have the manual in hand to discuss your query

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 to 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.

(Authorized Signatory)