

EQUIPMENT

Things you Need to Make Things

STORAGE AREAS

"EVERYTHING HAS A PLACE AND EVERYTHING IN IT."

- Your Mom

This lab is here for you to produce holograms of high quality and as efficiently as possible. By keeping things organized, your lab time will be much more fruitful. Do not rely on the Instructor or Departmental Assistants to clean up after you. If you're standing around waiting for things to settle, or holograms to dry, use that time effectively by putting anything you see that's out of place back where it belongs. When you're disassembling something, instead of putting things away just any old place, put them where they belong. The following maps will help you find the homes for your optics friends.

UNDER THE ISOLATION TABLES

* IMPORTANT PAPERS * MOVIE LIGHTS * VACUUM CLEANER * GARBAGE CANS
* GLUE GUNS *

GLASS CUTTING TOOLBOX

* THE GLASS CUTTER * BREAKING PLIERS * GROSZING PLIERS * STONE
FILE * GLASS MARKING PEN * OPTIONAL: GLASS DRILLING DIAMOND BIT *
CIRCLE CUTTER AND STRIPPER *

BEGINNING HOLOGRAPHY STUDIO INVENTORY

MELLES GRIOT LHP-171 He-Ne LASER
JODON SPATIAL FILTER AND ATTACHMENTS
TWO 8 BY 10 INCH MIRROR MOUNTS AND SUPPORT HARDWARE
TWO NEWPORT MM-2 MIRROR MOUNTS AND MAGNETIC BASE ASSEMBLIES
NEWPORT "U" 4 BY 5 INCH PLATEHOLDER ASSEMBLY
WOODEN 8 BY 10 INCH FILMHOLDER
POLARIZING BEAMSPLITTING CUBE ASSEMBLY
TWO HALF-WAVE PLATE ASSEMBLIES
DRILL PRESS VICES
S & M LIGHT METER
BINS OF CLAMPS, METAL PLATES, AND THREADED RODS

EVERYTHING ELSE IS IN THE PRINTER ROOM!

PRINTER ROOM SHELVING, WEST WALL

SPEAKER

ADHESIVES
RUBBER CEMENT
AND THINNER
GASKET SEALER

LARGE
OPTICAL
MOUNTS
NEWPORT
MODEL 410

NEWPORT
4 X 5 AND
8 X 10 INCH
PLATEHOLDERS

CONTACT
FRAME HOLDERS
30 BY 40 CM
FRAMED
WINDOW GLASS
AND GROUNDGLASS

PAINTS
FLAT AND GLOSS

EPOXY
WHITE WOOD GLUE
ELMERS STIX-ALL
SUPER GLUE
3-M Spra-Ment
DUCC CEMENT

LUBRICANTS

WD-40

#33 BLOCKING SPRAY

3-IN-1 SPRAY
CARBURATOR CLEANER

MISCELLANEOUS STORAGE

RAZOR BLADE LURKING ON MAG BASE

CLEANERS

BALL DRIVERS
CAN
GROOVED AND ALLEN WRENCHES
NEWPORT SCREW KITS
OF
POSTS
HOT GLUE SCRAPER

PHOTO-WIPES * Q-TIPS
BLOWER BULB * ACETONE
GLASS CLEANER * FANTASTIK
GLASS WAX * ACETONE
EDWAL ANTI-STATIC FILM CLEANER
KODAK LENS CLEANING FLUID
KODAK LENS CLEANING TISSUES
NOZZLE FROM AIR COMPRESSOR

ARGON LASER
AND BOLEX

C-CLAMPS

BAFFLING
MATERIALS

8 BY 10 GLASSES

30 BY 40 GLASSES

ALIGNMENT TOOLS
POLAROIDES
PROTRACTORS
OFFICIAL RULER
GNOMONS

FRESH
MIRRORS

RESALE
SUPPLY
STORAGE

BLACK VELVET AND CLOTHES

TRIPOD

LIGHT STANDS

WITH TALL RODS

MAG
BASES

LASER
MUSEUM

MISCELLANEOUS ELECTRICAL
AND LIGHTING SUPPLIES

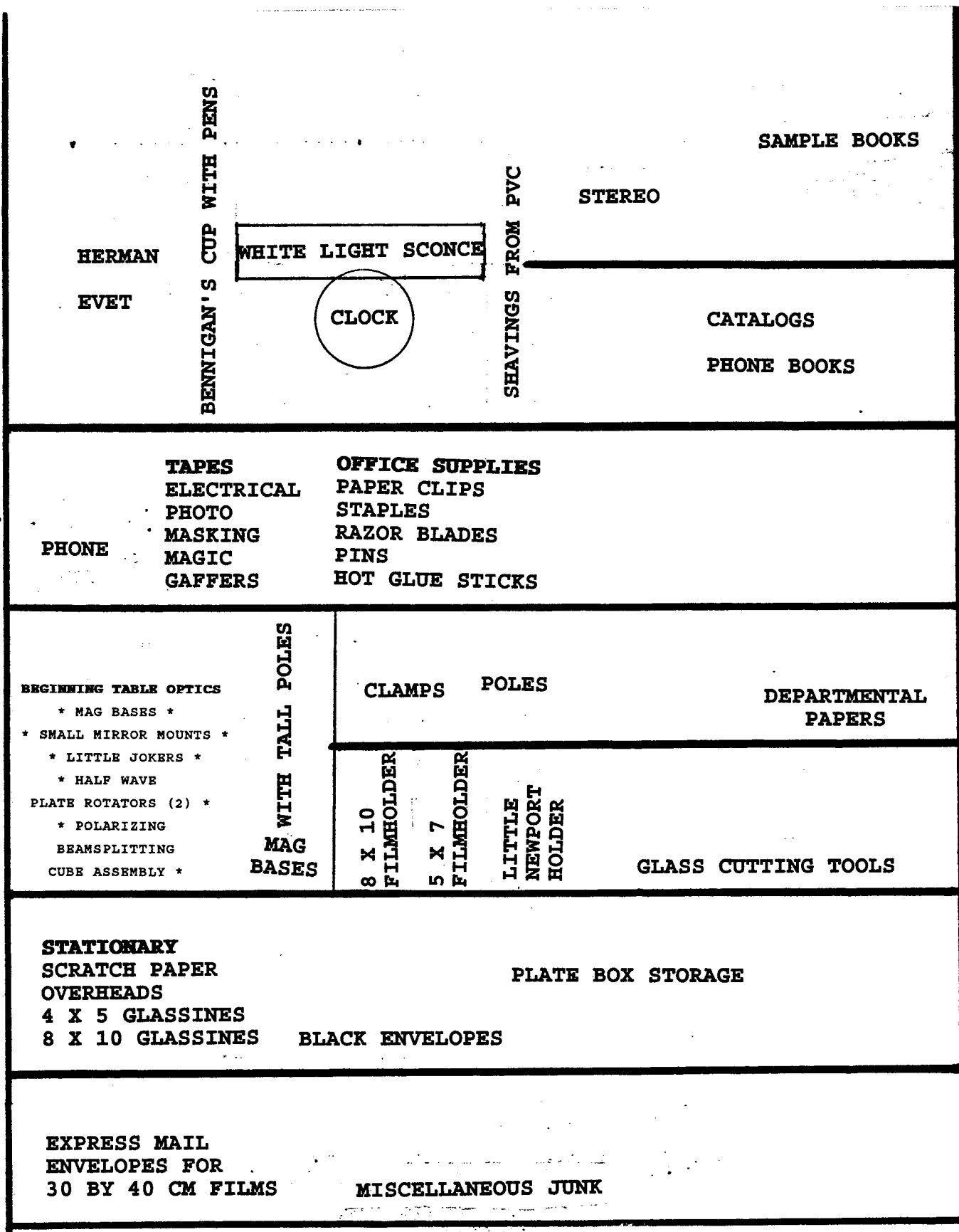
MISCELLANEOUS TUB UNDER SHELF ON FLOOR

PRINTER ROOM SHELVING, EAST WALL

SPEAKER	
	BINS OF METAL PIECES
	METAL BASES
CLAMPS	
INDICATOR BASES' CLAMPS AND RODS	LONG AND SHORT RODS
MISCELLANEOUS DEMONSTRATION HOLOS	LENSES
MISCELLANEOUS DEMONSTRATION HOLOS	
TOOLS	
DREMEL TOOL	
HOT GLUE GUN	
DRILL BITS	
TOOL BOX ON FLOOR	

FLOOR

NORTH WALL, EXPERIMENTAL LAB



DARKROOM SOUTH WALL REPLAY LIGHT		
MORTAR AND PESTLE	OLD BALANCES	WEIGHING TRAYS
DIGITAL SCALE		HAIR DRYERS HOT PLATE STIRRER
RECYCLED 4" by 5" GLASS PLATES		TELEPHONE
BLOOD BATH LIGHTS	COUNTER	PAPER CUTTERS
CHEMICALS		
REFRIGERATOR		
CHEMICALS		
CHEMICALS		
FLOOR		

EQUIPMENT ON EAST WALL OF DARKROOM (Not Shown)

* PAPER TOWELS * TOILET PAPER * PLUG BOX FOR COUNTER * PHONE *
 * MARKER BOARD * SAFE AND WHITE LIGHTS SWITCHES VICE VERSA'ED *

DARKROOM WEST WALL

WIRE FOR HANGING FILM WITH CLOTHESPINs

GLASSWARE

BEAKERS

GRADUATES

STIRRER
MAGNETS

SAFELIGHT

GRALAB 520

CHEMICAL
RESERVES

THERMOMETER

HOT WATER
FILTERTHERMOSTATIC
WATER CONTROLCOLD WATER
FILTER

FIRST AID KIT

BANDAIDS

CONDOMS

SILVERWARE

INSTANT COLD

ASPIRINS

SOAP

MIRROR

THERMOMETER
IN HOSEDEVELOPER
GRADUATE

SINK

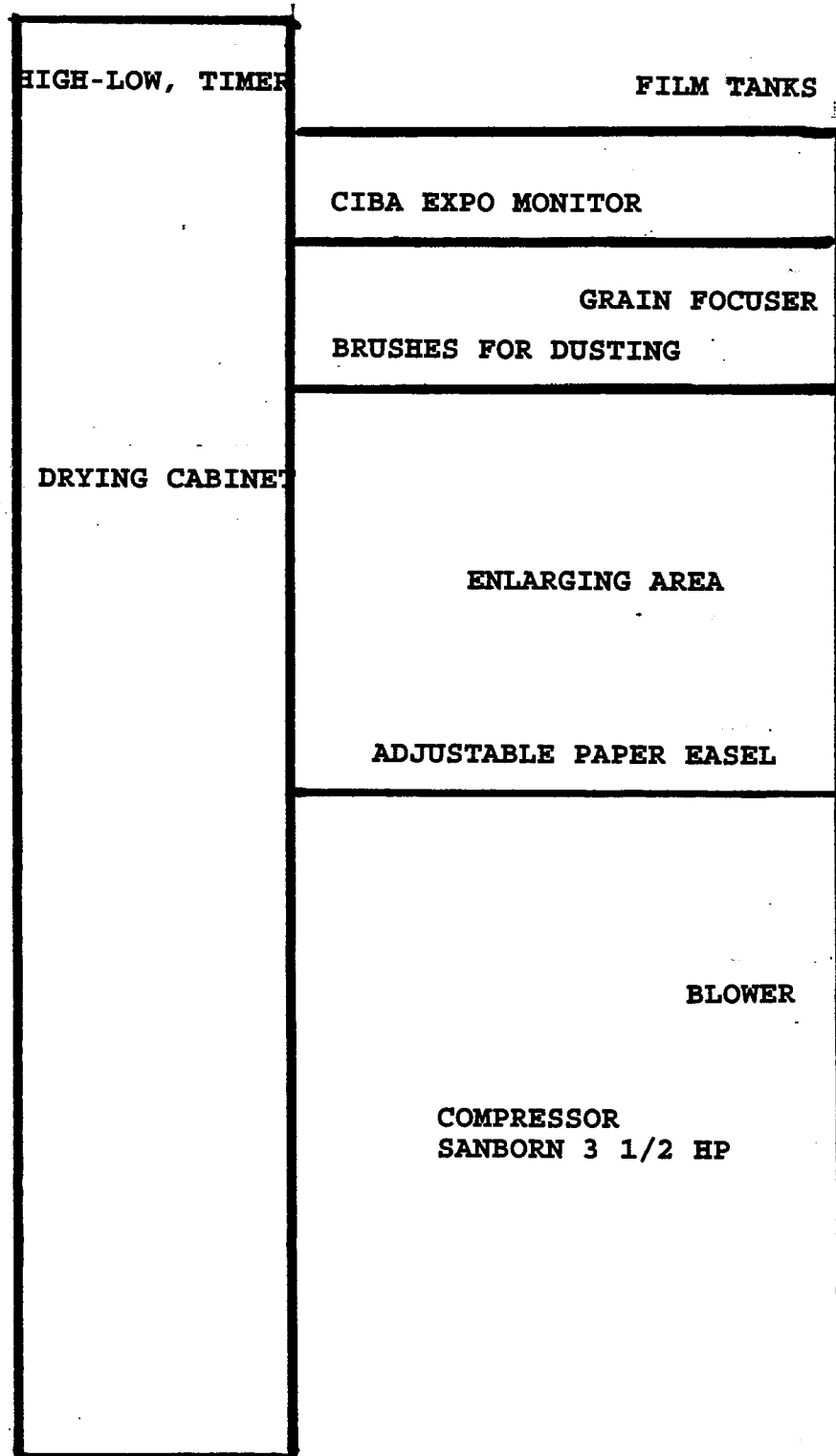
UNDER THE SINK

TRAY STORAGE

GARBAGE CAN

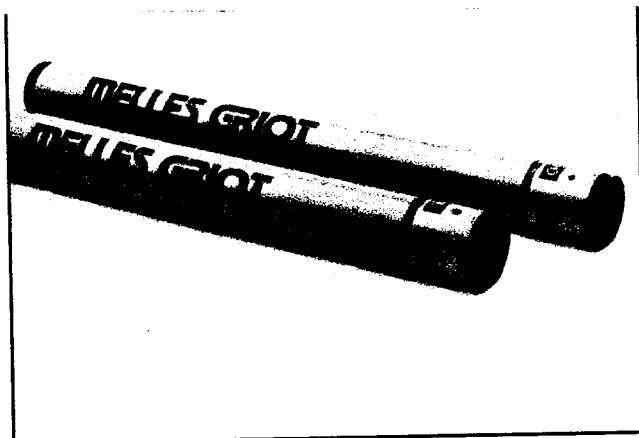
DRAINAGE FILTER

NEWSPAPERS FOR
SPRAY PAINTING

DARKROOM WEST WALL, CONTINUED

MICROSCOPE OBJECTIVE STORAGE BOX

JODON PINHOLES IN MAG-LITE CASE KODAK LENS CLEANING TISSUE AND FLUID	5X OBJECTIVES AND PINHOLES	20X OBJECTIVES AND PINHOLES
	10X OBJECTIVES AND PINHOLES	40X OBJECTIVES AND PINHOLES
	OPTICS OVERFLOW	60X OBJECTIVES AND PINHOLES



These Cylindrical Laser Heads are packaged red helium neon lasers. The power supply is separated from the laser head and the two are interconnected by a 1.8m cable. This allows certain mounting freedoms in restricted situations. The cylindrical housing is compatible with our 07 HLH 001, 07 HLH 002, 07 HLH 003 or 07 HLA 001 laser holders and other mechanical hardware components (see page 462).

The plasma tubes used in these lasers are the same as described earlier in this catalog and feature all the same advantages of stability, reliability and long-life. All BRH safety features are incorporated and the lasers are fully certified and labeled by Melles Griot.

Output powers of 1, 2, 4, 5 and 7 milliwatts are offered in both randomly and linearly polarized versions. The lasers are permanently and concentrically mounted within metal tubes for protection and ease of use. The connected cable is for the external power supply which should be ordered separately (see page 360).

Red HeNe Cylindrical Laser Heads

SPECIFICATIONS	05 LHP 171
Minimum CW Power Output at 632.8nm TEM ₀₀ : (mW)	7
Beam Diameter 1/e ² : (mm)	1.00
Beam Divergence: (mrad, full)	0.8
Polarization Ratio:	500:1
Longitudinal Mode Spacing: (MHz)	380
Operating Current, nominal: (mA)	7.0
Operating Voltage: (VDC) ±100	2600
Recommended Minimum Power Supply Resistance: (kΩ)	75
Weight: (kg)	0.68
Long Term Drift:	±2%
Starting Voltage: (kVDC)	> 10
Ballast:	Included

Common To All Product Numbers

Static Alignment:	Centered to outer cylinder within 0.25mm and 1.0 milliradian
Angular Drift:	<0.03 milliradians after 15 minutes.
Amplitude Noise:	<1% (30Hz to 10MHz rms)
Dimensions:	±0.5mm

RED HENE CYLINDRICAL LASER HEADS

MELLES GRIOT POLARIZED 7mW HELIUM-NEON LASER

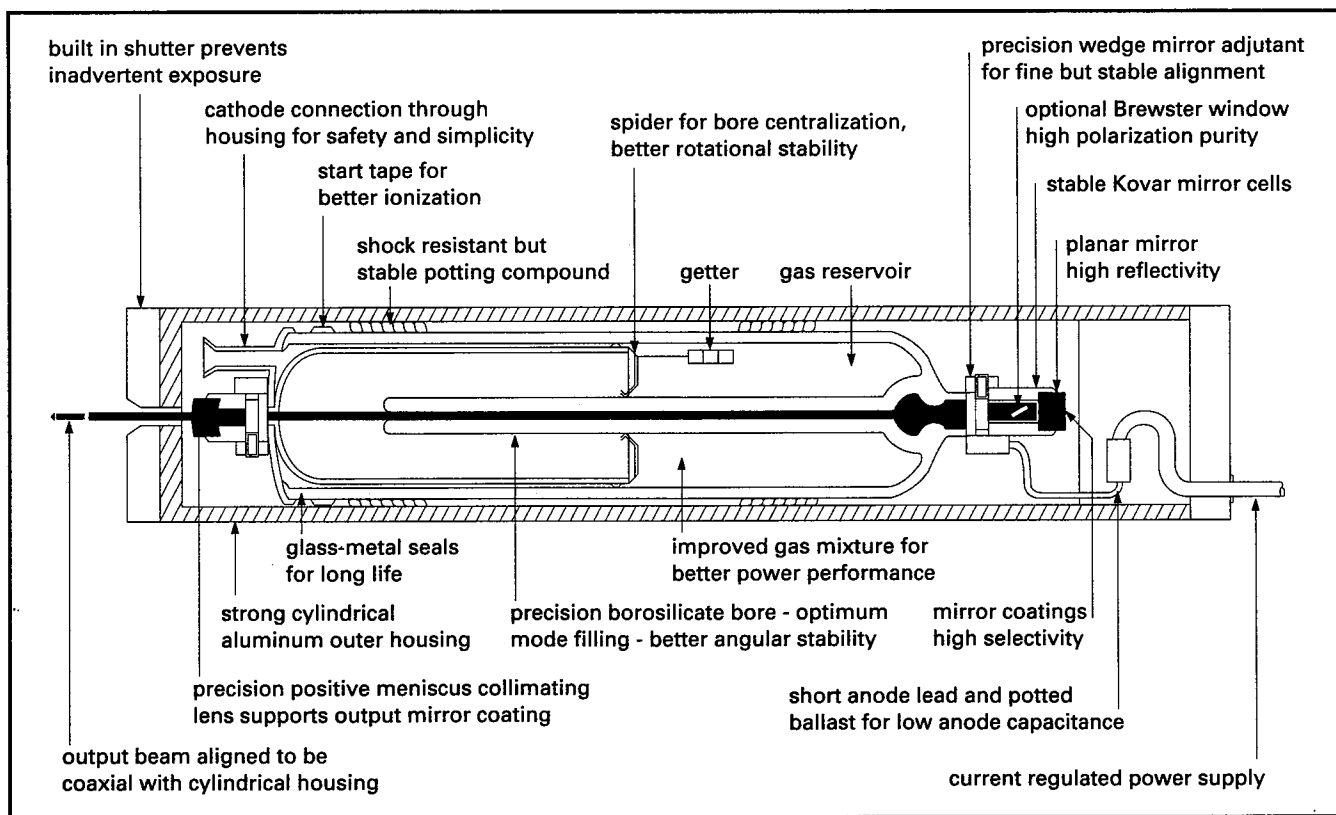
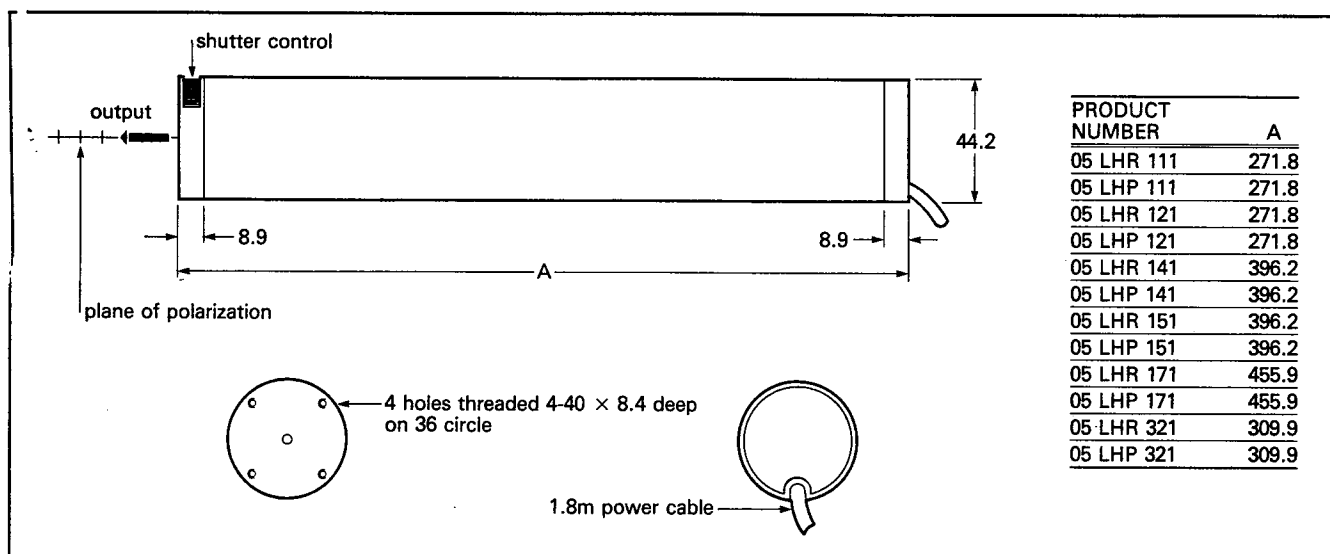
This is a decent-sized source of photons for the **Experimental Table**. Four by five and eight by ten inch holograms can be exposed with it in under a minute.

This laser still puts out >7mW, even though it's over ten years old. Melles Griot is the world's largest manufacturer of Helium Neon Lasers, and the tubes are well-sealed for longevity. Back then the manufacturer painted the laser heads and power supplies a unique beige color; nowadays they have followed everyone else and paint them black.

This Laser Head Polarized has its plane of polarization set by the **Brewster Window** inside the tube, and is aligned with the "tail" of the power cord exiting the rear of the laser.

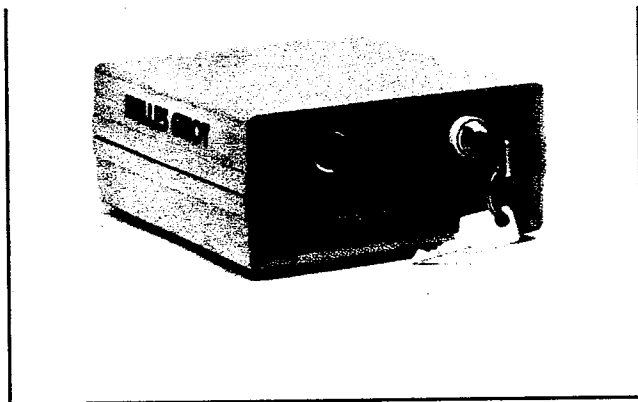
There is a **shutter** on the **output end cap**. If there is no emission, and the tube is warm, then the shutter is closed. It is rather stiff opening or closing it.

Environmental Specifications	Operating	Non-Operating
Temperature:	-20 to +50 °C	-40 to +80 °C
Altitude:	0 to 3000 meters	0 to 5800 meters
Relative Humidity:	0 to 100%	0 to 100%
Shock:	15g for 11msec	15g for 11msec



CROSS-SECTIONAL VIEW OF A MELLES GRIOT HELIUM NEON LASER HEAD showing the details of the plasma tube.

FURTHER READING: The latest **OPTICS GUIDE** from Melles Griot.

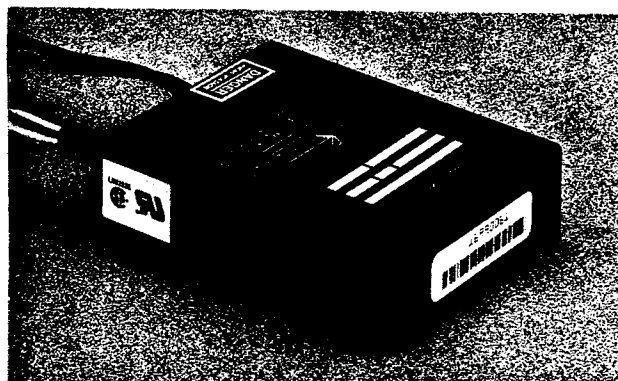


These power supplies are designed specifically for use with Melles Griot cylindrical laser heads as previously described. Four versions are available: one to drive red lasers with 1 to 5mW output power, one for use with the 7mW lasers, one for use with green lasers, and one for use with infrared lasers. All models may be operated from either 115 or 230VAC (50 or 60Hz). They incorporate all required BRH safety features such as key-locks, power-on indicator and a 3 to 5 second operating time delay.

Power Supplies are packaged in a plastic housing. A 1.8 meter line cord plugs into the rear of the supply. Also provided are output sockets for the laser head and a replaceable-fuse holder.

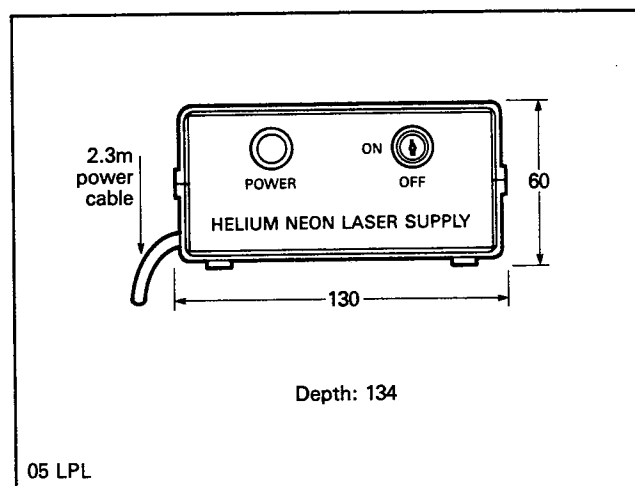
SPECIFICATIONS	05 LPL 370
Power Range of Lasers Driven: (mW)	7
Input Voltage: (VAC)	115/230 \pm 10%
Input Frequency: (Hz)	50 or 60
Input Current: (mA average)	120/60
Recommended Fusing: (A)	1.0
Output Current: (mA)	7.0 \pm 0.5
Laser Beam Amplitude	
Ripple: (% rms)	0.2
Operating Voltage: (VDC)	2500-2700
Starting Voltage: (kVDC)	10
Conversion Efficiency: (%)	87
Heat Sink:	None Required
Required Ballast:	None
BRH Time Delay: (sec)	3 to 5
Dimensions: (mm)	\pm 0.5

The old 05 LPL 370 went out with a whimper and now we use a **MWK Industries Item 24ANS12 COMPLETE SELF-CONTAINED He-Ne POWER SUPPLY** for the juice to lase the Neon atoms. It turns on with a **Rocker Switch** rather than the **Key** of the original. **NEVER, EVER SWITCH ON THE POWER SUPPLY WITHOUT A LASER ATTACHED!**



If the **Rocker Switch** is pressed and the **Indicator Light** doesn't come on, check the electrical plug and plug box **ON THE Control Panel**. If the **Indicator Light** is on, the laser may take a while before it emits as there is a federally-mandated delay built-in to the **Power Supply**. If the laser has been sitting for a while, like days or weeks it may take a matter of minutes before it lights.

There is a little **Black Box** inside all these **Power Supply Boxes** that has unmarked electrical components that not only transform and rectify the household current to satisfy the laser but there also is a time bomb ticking in it. If the laser doesn't light after about a half an hour, the **Power Supply** is probably dead. This laser is on its third one.



HELIUM NEON LABORATORY LASERS

Melles Griot helium neon lasers are reliable, trouble-free laboratory tools which provide the user with stable, directional, monochromatic beams of coherent light. Three output wavelength versions are available, green (543.5nm), red (632.8nm), and infrared (1523.5nm). Both linearly polarized and randomly polarized beam outputs are available at most wavelengths. Built-in power supplies facilitate operation by simply plugging the laser into a normal grounded AC outlet.

The amplification and directionality of the output beam depends on a stable set of mechanical, optical, environmental and electrical conditions. Producing and maintaining these stable conditions requires not only controlled and repeatable manufacturing conditions, but also a skillful understanding of the whole system design.

The following pages will provide you with insight into the design of a laser system.

WARRANTY

Melles Griot helium neon lasers and their power supplies are guaranteed to operate to specification for 18 months after the date of your purchase. If for any reason, other than breakage or abuse, they should fail to perform to this level, we will replace them free of charge. This is, we believe, the best warranty in the business. It reflects our confidence in these lasers and our belief that they will have a long and trouble free life. If you should ever have reason to use this warranty provision, we request that you contact one of our

offices for shipping instructions prior to returning the laser.

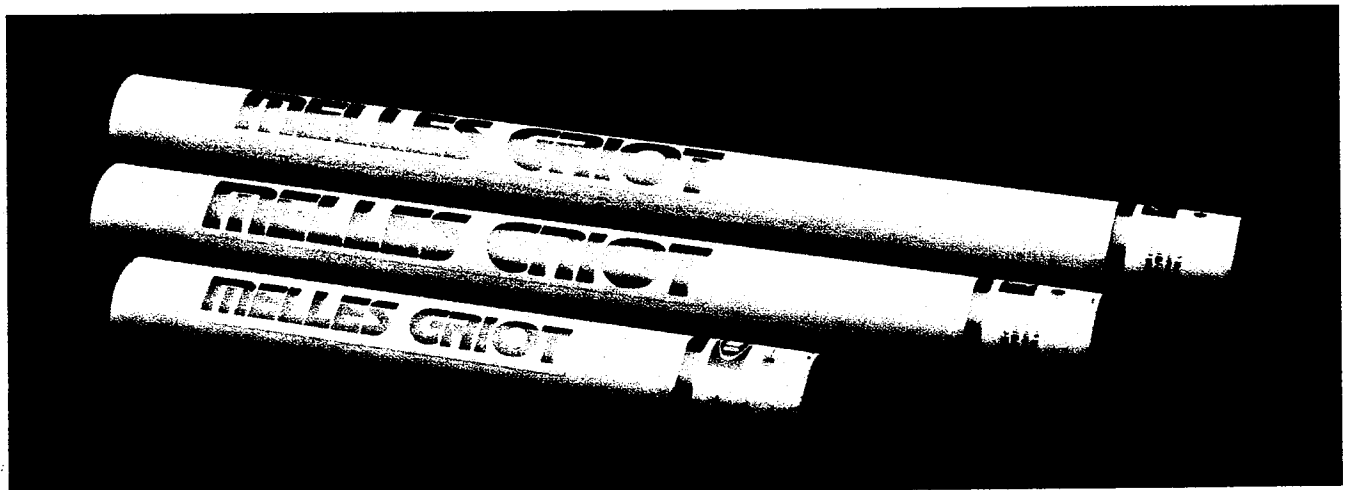
A complete copy of our warranty is packed with every laser that we ship.

LASER SAFETY

Melles Griot helium neon lasers are low output power devices which emit only non-ionizing radiation at 543.5, 632.8 or 1523.5 nanometers. They emit no X-rays or other harmful radiation. They have been designed and built to comply with the relevant United States federal regulations contained in 21 CFR, Chapter 1, Subchapter J. Warning labels are affixed to each laser for identification and safety.

A number of specific safety features are built into Melles Griot lasers for your protection. A green pilot light on the rear panel indicates that the power supply is on and warns that laser radiation may be present. A delay is built into the power supply so that power is not passed to the plasma tube until 3 to 5 seconds after the pilot light goes on. Also, a mechanical shutter, which can be closed when the laser is not in use, is built into the front of our lasers to prevent inadvertent exposure to the beam. In this way, the laser beam may be interrupted without forcing the laser to cool down from its stable operating condition.

As with any extremely bright light source, common sense is most important. DO NOT look directly into the laser beam or at any specular reflections of the laser beam.



EXPERIMENTAL TABLE CONTROL PANEL

Attached to a crosspiece of the Isolation Superstructure for the **Experimental Table** is a **CONTROL PANEL** which operates the major subsystems of the Table. At the left is the fourth power supply for the **Melles Griot Model LHP-171**, an **MWK Industries Item 24ANS12 COMPLETE SELF-CONTAINED HeNe POWER SUPPLY***. Simply flipping its **Rocker Switch** should energize the laser. The light on the **Power Supply** should glow promptly. However, there is a delay built into the **Power Supply**, so the laser does not come on immediately. On top of that, the laser may be hard-starting after long periods of unuse; minutes may sometimes elapse before emission occurs. Before despairing over the inaction of the laser, check to see that the **Plug Box** (also known as a **Power Strip**) is turned on, with its **Red Neon Indicator** aglow, and that the **Built-in Shutter** at the end of the laser is open. **NEVER, EVER, TURN ON THE POWER SUPPLY WITHOUT A LASER PLUGGED INTO IT!** No load running will burn out most laser power supplies.

Unblocking of the laser beam to initiate an exposure is accomplished by moving a piece of cardboard on the end of a pole attached to a 12 VDC rotary solenoid, designed and fabricated by Dean Randazzo (MFA SAIC '91). When current is applied to this device, an electromagnet pulls a rod into itself, through a cylinder that has a coarse thread tapped into it, so that the translation is turned into a 90 degree rotation. It makes a loud clack when energized, so it is mounted off the table.

The conversion of 120 VAC into 12VDC is accomplished by first a transformer to drop the voltage, then a couple of capacitors are used to smooth out the AC ripple. This unit, built here at the School by Ed Bennett, plugs into an ordinary photographic enlarger timer, an **EPOI Printrol**. This unit came to us from the **SAIC Photography Department**, by way of the **Electronics Department Scrapyard**. It was carefully gleaned out of a box of many.

Ordinarily an enlarger is plugged into the timer's enlarger outlet, and is turned on for the selected length of time to expose a photographic print. This is the outlet that the shutter transformer is plugged into. The safelight plug is only live when the rocker switch is in the **TIME** position and the timing circuit is off, so it may be useful, like plugging a glue gun into it. The third plug is for a special footswitch trigger, which would be useful in a photographic darkroom during dodging and burning in operations when the photographer's hands would be

*. Laser tubes are quite rugged and long-lasting; power supplies are made to blow quickly and be replaced entirely, as there is no way of repairing them.

used and unable to start the timer with the RED BUTTON. Jesus Lopez adapted the Remote Control Button from a Newport Model 845HP Digital Shutter System. (See the Handout, **BOGUS NEWPORT EQUIPMENT.**)

The other positions of the rocker switch either turn the unit off (**OFF**, in the center), or the **FOCUS** position will open the shutter for as long as it is in that position. In the darkroom this feature would be used to turn on the enlarger's bulb so that composing, cropping, focussing, filtering and irisng can be observed. So too it can be used to let the laser beam out to check alignment, polarization, beam balance ratios, spatial filter state of tune, etc. But the electromagnet in the shutter unit will heat up if energized for extended periods of time, so it is best to move it out of the way during a long and agonizing initial set up.

The two **ROTARY SWITCHES** are numbered 0 to 10 each, so 1 to 110 second exposures are possible if the **MULTIPLIER SWITCH** is slid to the **X1** position, or by sliding it to the **X.1** place the times are shortened by a factor of ten to a .1 to 11 second range.

If this unit fails: Check all cords and connections, with the timer unplugged. If they are all sound, then the most likely problem is the timer itself has failed. Then use a piece of cardboard placed in front of the laser to shut off the beam, and use your pulse which is usually about a pulse per second, to time the duration, if you don't have a watch.

In the lower right corner is a small sliding switch which controls the **Fluorescent Light** over the **Table** under the **Superstructure**. Normally it is more convenient to use the **Pull-String** which entwines the roof of the **Superstructure**. If that doesn't seem to be working, make sure the little **Switch** is up for on.

FOR YOUR INFORMATION: (From **ART HAZARDS NEWS**, Vol. 14, No. 5, 1991, pp. 1-2.

Lasers in Art

By *Michael McCann, Ph.D., C.I.H.*

Lasers are used in art on stage, in laser light shows, in concerts, and in holography, to name a few applications. A laser is a device that can produce or amplify light of a particular wavelength or range of wavelengths. Laser beams can cause eye damage, skin damage, and present other hazards depending on the type of laser.

Classification

Lasers are classified into categories based on their hazards. Class 1 lasers are the lowest power lasers and do not emit hazardous levels of energy under normal operating conditions. Class IIa lasers are low power lasers which represent eye hazards only if viewed for more than 1000 seconds; Class II lasers are considered chronic hazards from any prolonged viewing. Class IIIa lasers, usually less than 5 milliwatts power, are chronic eye hazards and may be acute eye hazards by viewing through optical instruments or directly. Class IIIb lasers can extend in power up to 0.5 watts, and are both acute skin and eye hazards from direct radiation. Class IV lasers are lasers of power greater than 0.5 watts which are acute skin and eye hazards by both direct and scattered radiation.

Regulations

The use of lasers is regulated by the Food and Drug Administration's Center for Devices and Radiological Health (formerly the Bureau of Radiological Health) under Public Law 90-602, "The Radiation Control for Health and Safety Act of 1968." Lasers for use in entertainment, such as light shows where the public is present, are regulated as demonstration lasers. Under these regulations, reports on the laser and the light show have to be filed. These regulations only allow the use of Class I, IIa, II, and IIIa lasers. To use Class IIIb or Class IV lasers in a light show, a variance must be obtained. This variance spells out in detail exactly how the laser can be used.

Lasers that are used on closed motion picture sets (no public allowed) are regulated by OSHA under the general duty clause, rather than by the FDA. OSHA usually uses the ANSI standard for laser safety. Unfortunately, this standard is mostly aimed at industrial use of lasers. If an outside company is used to provide the laser light show effects for a motion picture, they would have to have a variance for a laser stronger greater than Class IIIa, and

must use trained operators. Even though the FDA regulations are not mandatory for closed motion picture sets with no public, they do represent good practice and I recommend using them.

In addition to federal regulations, there can be state and local regulations. At present, New York is the only state that requires licensing of laser operators. Some other states like Texas require that lasers be operated by qualified personnel, without defining the term "qualified". Many states and cities require licensing of the lasers. Outdoor laser shows (including testing of the laser) that involve projection of the laser beam into open airspace require prior approval of the Federal Aviation Administration (FAA).

Recommendations

The following recommendations are based on the FDA recommendations for laser light shows and displays.

1. All lasers must be labeled with their classification and appropriate warnings. If the laser is more powerful than Class IIIa, obtain a copy of the variance if an outside laser consultant is used. Also check the certification of the laser and qualifications of the laser operator.
2. All lasers must have a protective housing which prevents exposure to more than Class I radiation levels, and safety interlocks so the laser cannot operate when the laser or protective housing is removed. Class IIIb or IV lasers must have a key-actuated master control.
3. There should be written procedures for setting up, alignment, and testing of lasers prior to use.
4. Only Class I lasers may be directly viewed (that is, the laser beam coming from the front). However, as a matter of good practice, no laser beam should be stared at.
5. Audiences may only be exposed to Class I radiation levels. According to the FDA regulations, employees can be exposed to Class II and IIa laser radiation levels as long as any direct viewing is only by accident for very brief periods. However, for performers on a motion picture set who are not trained in the hazards of lasers, it is recommended that they be considered as audience, and only be exposed to Class I radiation levels. Laser operators and other trained crew could be exposed to Class II levels.
6. Class IIIa, IIIb, and IV lasers should not contact any part of the human body. For unattended lasers, the radiation levels must not exceed Class II levels inside a region 6 meters above the floor, 2.5 meters below the floor, and 2.5 meters laterally from where a person could stand. If a laser operator is present, the vertical separation could be 3 meters. The laser beam can be less than 2.5 meters in lateral distance or below the floor if physical barriers prevent access to higher than Class II levels. The laser operator should have a clear view of all laser beams and people in the area, and have no other responsibilities.
7. Audience scanning involves the passing of direct or reflected laser beams of radiation exceeding Class I levels across the audience. This could be achieved directly or through the use of rotating mirrored balls, for example. The amount of exposure to the audience must be reduced to below Class I levels by scanning devices. The scanning device must have a scanning safeguard to rapidly shut off the laser if a malfunction of the scanner increases exposure to laser radiation above these levels. In certain instances the rotating mirrored balls might also need scanning safeguards since if the mirror rotation slowed or stopped, there could be increased exposure to laser radiation in some locations.
8. Laser radiation levels scattered by, fogs, smoke, mist or similar diffusing media should be at Class I levels where the audience could be exposed.
9. All lasers should have emergency shut-offs in case of any malfunction.

THE OFFITIAL (sic) RULER

The OFFITIAL RULER is a specially marked white plastic 12" ruler (Sterling 515) that is eminently useful in the SAIC HOLOGRAPHY STUDIO, for it has the OFFITIAL BEAM HEIGHTS for all the ISOLATION TABLES recorded in Sharpie and Gold Marker. The white plastic diffusely reflects and transmits, so that beam heights can be read from the front or back of the ruler.

The beam height above the tabletop on the EXPERIMENTAL TABLE is 21.9 cm or 8 5/8 inches. It is marked in Gold Marker. This is the height that the laser is positioned, and was chosen because the center of the 8 by 10 inch HOLOGRAPHIC FILMHOLDER when held on a goalpost set up longways vertical is at that altitude.

The beam height above the table on the HOLOGRAPHIC STEREOGRAM PRINTER is 28.5 cm or 11 1/4 inches. It is denoted by the MT marks. This height is the center of the HOLOGRAPHIC FILMHOLDER.

The beam height for the TRANSFER TABLE is 23 cm or 9 1/16 inches. It is marked TT. This height is the center of the MASTER PLATEHOLDER.

Since this tool is so very useful, its location should be given the utmost importance. Its storage area is either in the bin in the PRINTER ROOM marked LINE UP TOOLS or hanging with the other rulers on the Superstructure of the TRANSFER TABLE.

USES: To Level an Undiverged Beam with Respect to the Tabletop, have a partner hold the OFFITIAL RULER or clamp it between two CHEAPO MAGNETIC BASES and manipulate each mirror in turn starting with the one nearest the LASER and working to the final destination to that the dot of light is at the appropriate level.

To Level a Diverged Beam with Respect to the Tabletop, first cut a piece of paper or cardboard so that its top edge is at the **OFFICIAL BEAM HEIGHT** and prop it up in front of the **MIRROR** to be manipulated. This casts a half-beam shadow. Have a partner hold the **OFFICIAL RULER** or clamp it between two **CHEAPO MAGNETIC BASES** and manipulate the mirror so that the diameter of the half-shadow is at the **OFFICIAL BEAM HEIGHT** at its destination.

MAGNETIC BASES

Magnetic bases provide a convenient and stable method of positioning optical components. A magnetic field clamps the base to a ferromagnetic plate. The handle actually does not move the magnet into position to attract the table but moves a piece of metal which shunts the magnetic field into itself, acting as a barrier to the magnetic force, out of the way. In this way both the north and south poles of the magnet contribute to the holding force, making a strong bond.

The principle was pioneered by the Gaertner Scientific Corporation of Chicago¹, at the suggestion of Dr. T. Jeong. It has its roots in Magnetic bases that are used in machine shops to hold gauges for measuring flatness or roundness. They are the most popular mounting system in use in the optics field.

The bases are the foundation of the rod and clamp system of fixturing, with rods screwed into them directly, or thick support post holders (see Gaertner Picture) screwed into the base and a rod dropped into it, all the way to the bottom preferably, for the maximum stability. This makes for a much sturdier assembly.

We have six different types of magnetic bases. A description of each follows. It is surprising that all the different types follow the same protocol in switching on and off: to the right to unlock, to the left to activate.

The typical way to implement them is to have the support post or rod oriented vertically, with a right angle clamp connecting the optic to it. This system allows the greatest variety of positioning variations: the base can be moved in the plane of the table, and the clamp can be moved up or down the post, for translation in the X, Y, and Z axes. The optic's rod can be rotated in the clamp to align it parallel to the table top or in the case of ascending or descending beams to align the optic's central axis with the laser beam's.

NEWPORT: We have three variations of the NEWPORT bases: The classic Model 100, "Compact Heavy Duty Base", and the newer Model 110, with the "kinematic" top, which have been removed, as they really don't relocate like they say, plus it seemed to make the unit unstable. But in their defense, they do have the strongest magnets of the bunch.

There is also a Model 150, "Low Profile, Heavy Duty Base", which is the only base Newport makes that will accommodate their damped rods. It is tied up in the transfer set up. For your inconvenience the unit is turned off using an Allen Key, but don't let that worry you because there is no need to ever move it from its position. There are also a couple of MB-1 "Utility Baseplates", neglected in the CLAMP DRAWER of the FILING CABINET.

All the holes on the NEWPORT bases are 1/4"-20, so that rods or VPH-2, 3, 6 can be attached to them.

¹ Great Art Deco factory building at 1201 West Wrightwood Avenue, Chicago, IL 60614, just a few blocks west of Club 950 a.k.a. The Lucky Number.

Magnetic Bases

Magnetic Bases reduce experimental set-up time significantly, as they allow free positioning and instant clamp-down of components. They are ideal accessories for all laboratories with ferromagnetic work surfaces such as Newport optical tables or breadboards. Newport offers a selection of magnetic bases with cost and performance options to satisfy every requirement.

Newport magnetic bases use strong, compact magnets in a switchable magnetic circuit that provides the highest holding force for their size along with convenient switching for quick repositioning. We paid special attention to the choice of magnets and details of the magnetic circuit design to ensure that the maximum holding force of Newport bases remains constant over time. And if your needs require it, our

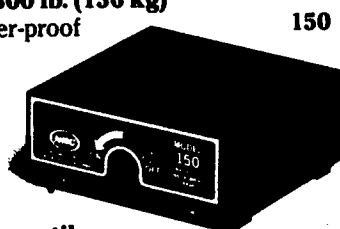
Models 100, 150, and 200 offer exceptionally low flux leakage for safe operation near photomultipliers and other sensitive equipment.

For maximum holding power, magnetic bases should be used on unpainted ferromagnetic surfaces at least 3/16 in. (5 mm) thick (for 410 or 430 stainless steel). Even thin layers of paint or powder coating will significantly reduce the holding force of any magnetic base.

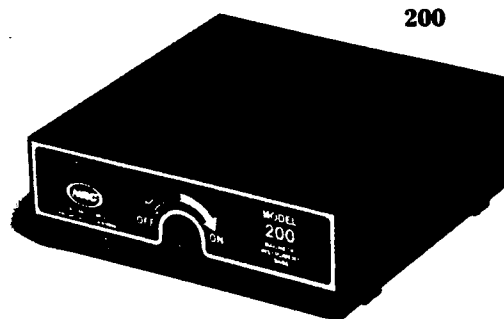
Also see Newport's **BU Series Universal Bases** (page D-8) and **BK Series Kinematic Bases** (page G-7). These provide single-bolt tie-down, anywhere on an optical table, for component positioning almost as convenient as with magnetic bases.

Low-Profile, Heavy Duty Bases

- **Highest holding force available— up to 300 lb. (136 kg)**
Continuously variable from two sides; tamper-proof lockdown
- **Stable magnets**
Holding force does not degrade with use
- **Wide, stable low-profile base**
Suitable for cantilevered loads
- **Non-magnetic mounting surfaces with versatile hole patterns**
- **Low field leakage— safe for use near sensitive equipment**



150



200

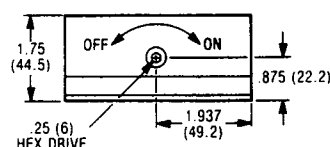
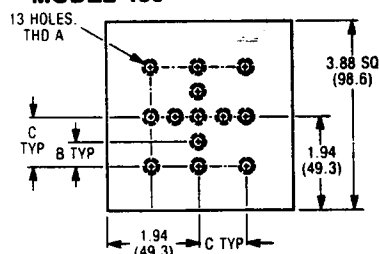
Newport's **Models 150 and 200** are premier magnetic bases that combine all the most desirable features: a large holding force that does not degrade with use, a low profile, mounting flexibility, exceptionally low field leakage, continuously variable force with easy-to-reach adjustments, and a non-magnetic mounting surface.

These bases incorporate a carefully engineered, stable magnetic circuit design which involves a linear translation of the magnets to turn the holding force OFF and ON. As the magnets are translated by a rotating leadscrew, the magnetic flux is routed either through the table surface—

producing the strong holding force—or contained entirely in the base—allowing quick repositioning of components. An inset adjustment screw which varies the holding force is conveniently accessible from either side of the base. Four turns of the ball driver (supplied with each base) vary the force from full ON to full OFF. Using a ball driver instead of a thumbwheel ensures that the bases can be adjusted even when oversized components are mounted.

Both bases feature a versatile array of tapped mounting holes for mounting Newport components.

MODEL 150

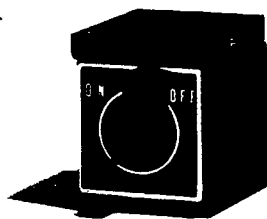
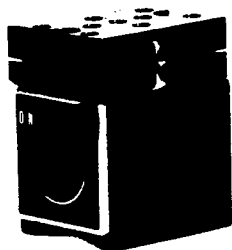


MODEL	THREAD	
	A	B
ENGLISH		
150	1/4-20	.500
200	1/4-20	.500
METRIC		
M-150	M6	12.5
M-200	M6	12.5

Magnetic Bases

Holding Force [lb. (kg)]	English Model	Metric Model
Low-Profile Heavy Duty Bases		
300 (136)	200	M-200
200 (90)	150	M-150
Compact Heavy-Duty Base		
200 (90)	100	M-100
Economy Base		
75 (34)	MB-2	M-MB-2
Utility Baseplate		
4.0 (1.8)	MB-1	M-MB-1

110



Includes
kinematic
top
plate

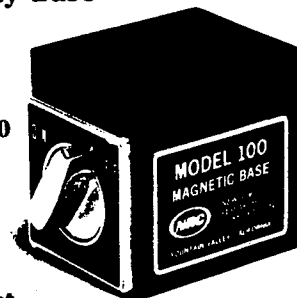


Model 110's kinematic top plate provides sub-milliradian position repeatability at no extra cost.

NEW

Compact Heavy-Duty Base

100



Kinematic, Heavy-Duty Magnetic Base

- **New— the industry's first kinematic magnetic base**
Standard kinematic top plate for repeatable positioning
- **Compact size with generous hole pattern**
Combines easy component mounting with close spacing capability
- **Non-magnetic mounting surface**
- **High holding force**

Newport's unique new **Model 110 Kinematic Magnetic Base** is a space-efficient base that adds an inset kinematic interface to a generous array of tapped mounting holes. Components may be attached directly to the base, or the unique kinematic top plate lets you remove components and replace them in position—reliably, time after time.

This base is the totally new replacement to our popular Model 100 base. It offers the same platform height, non-magnetic mounting surface, convenient on/off knob and similar package size. Enhancements include an improved magnet, an even more generous mounting hole pattern, and the unique kinematic top plate. Model 110 may also be attached to tables on its side. Yet even with these new features, it is still priced to fit any budget.

The kinematic top plate is equipped with spring-steel clamping hooks which hold the kinematic plates together. Alternatively, two bolts may be used to clamp the plates together. This provides secure clamp-down of cantilevered or rod-mounted loads. The locking bolts are accessible even when a standard 1.5 inch (38 mm) rod is attached. Extra kinematic top plates may be purchased.

- **Strong, stable magnet**
200 lb. (90 kg) holding force does not degrade with use
- **Compact size allows close component spacing**
- **Low field leakage**
- **Non-magnetic mounting surface with versatile hole patterns**

Newport's **Model 100** is a space-efficient magnetic base with exceptionally high holding force for its size. A simple 90° rotation of its locking knob attaches it securely to a ferromagnetic surface. Field leakage is low, so Model 100 may be used in proximity to sensitive electronic equipment.

Model 100 has a convenient array of tapped mounting holes for mounting components, including **Models 40 and 70 Rods** (page G-9). Its mounting surface is non-magnetic, so ferromagnetic components may be mounted without degrading its holding force. If a larger mounting surface is needed, the **Model 38 Platform** (page G-13) is useful.

Utility Baseplate

MB-1

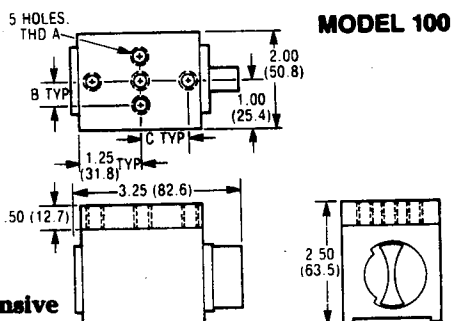


- **New 4.0 lb (1.8 kg) holding force**

Small components can be quickly positioned on ferromagnetic optical tables and breadboards using the **MB-1 Utility Baseplate**. It features an improved magnet for greater holding force. Components mount to the MB-1 by a single bolt.

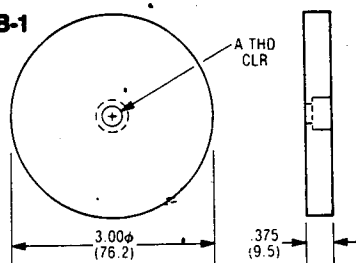
Ordering Information

	English Model	Metric Model	Price
Low profile, heavy duty Bases	200 150	M-200 M-150	\$265 \$245
Kinematic Magnetic Base	110	M-110	\$155
Compact Base	MB-2A	M-MB-2A	\$ 55
Micro Magnetic Base	MMB	M-MMB	\$ 35
Utility Baseplate	MB-1	M-MB-1	\$ 35
Extra Kinematic Top Plate for Model 110:	BK-1T	M-BK-1T	\$ 32

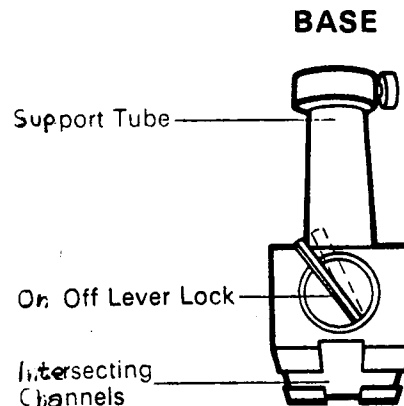


- **Inexpensive**

MODEL MB-1



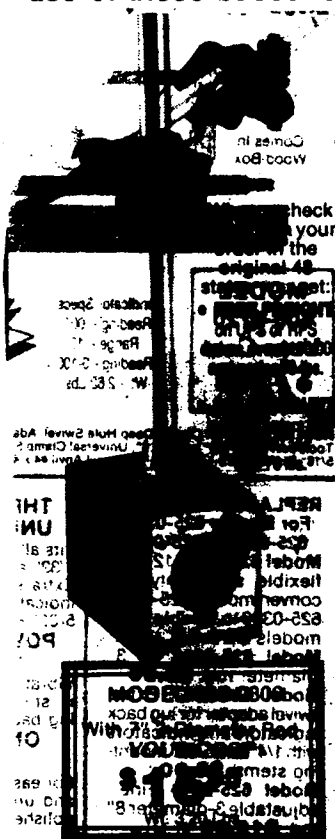
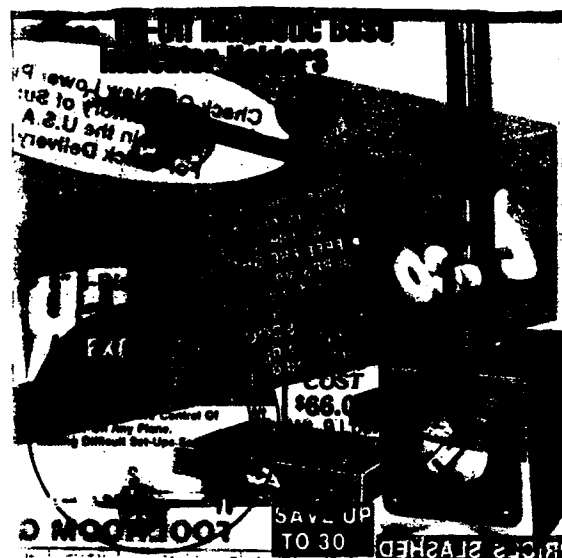
GAERTNER: These are from the earliest incarnation of the Holography Department at SAIC. They are grey with a chrome knob, and there are support post holders that fit onto them of the same color, along with some homemade ones. Notice that they made the bases with four feet on the bottom, and they will sometimes rock unless the magnet is turned on. It may be necessary to hot glue the base to the table in critical applications. The thread in the center of the base is 3/8"-13, while the four smaller corner holes are 8-32, which are useful for attaching a Newport B-2 to it as an interface between the two different manufacturers.



EMCO: These are from a company which distributes products from the Far East. We have samples of two catalog numbers. The smaller ones seem to be losing their handles, so if you see any floating around the lab, put them with the bases or in a **MISCELLANEOUS METAL PARTS** box. The magnets weren't so strong to begin with, and some of them it's hard to tell if the magnetic field is on or off, so reserve the use of these bases for lightweight

things. The hole on top is 5/16"-18, and some of the Newport VPH-4's had their bottom

1/4"-20 thread drilled out to provide a clean hole for a 5/16" bolt to pass through to attach it to the base, like the holders for the Beginning Table's half-wave plate rotator and polarizing beamsplitter cube assemblies. It is best not to disassemble them. The chrome-plated rods which came with them are also usable, and the clamping hardware show in the picture is in the **CLAMP DRAWER**. We ordered the larger one several different times, and although the catalog number was always the same, red, black, and blue bases arrived. They have some sort of metric thread in them, so they are best used with the chrome-plated rods that came with them.

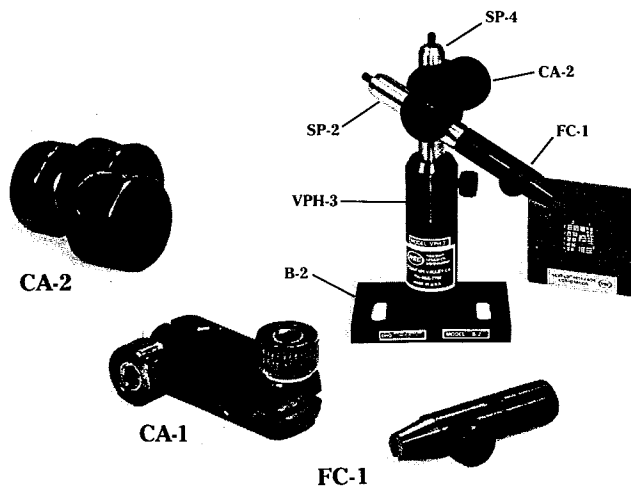


CLAMPS

The **HOLOGRAPHY LAB** boasts a plethora of devices for your clamping needs. The storage place for the bulk of them is in a **BIG BLUE BIN** in the **EAST WALL STORAGE ARE** of the **PRINTER ROOM**, with a generous assortment of the commonly used types in a **Coffee Can** in the **EXPERIMENTAL LAB**.

We have some **CA-1** and **CA-2** Clamps, but no **FC-1s**. The **CA-2** is actually quite a useful piece, as it can position two half-inch rods at any angle between them, which is handy for working in tight places. A ball driver may be necessary to torque the thing down properly, and if the weight is not too much then there should be no drift.

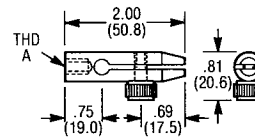
Post Clamps and Adaptors



Post Clamps and Adaptors

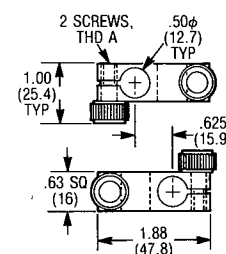
	English Model	Metric Model
Cross-Post Adaptor	CA-1	M-CA-1
Universal Clamp	CA-2	M-CA-2
Filter Clamp	FC-1	M-FC-1

MODEL FC-1

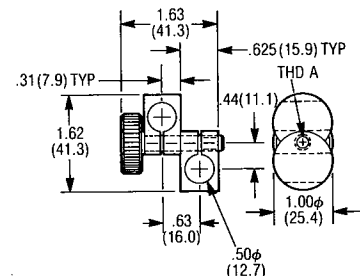


MODEL	THREAD A
	ENGLISH
CA-1	1/4-20
CA-2	1/4-20
FC-1	1/4-20
MODEL	METRIC
M-CA-1	M6
M-CA-2	M6
M-FC-1	M6

MODEL CA-1



MODEL CA-2



CA-1 Cross-Post Adaptor mounts two SP Series posts at 90° with respect to each other. The clamping screws permit fast, secure post mounting with only moderate finger pressure.

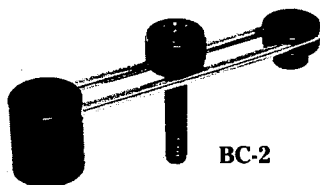
CA-2 Universal Clamp holds two SP Series Posts at an arbitrary angle with respect to each other. Both posts are tightened simultaneously with the knurled knob.

FC-1 Filter Clamp is a convenient device for holding thin objects such as optical filters, transparencies or even razor blades used as knife edges. A 1/4-20 mounting stud may be threaded into the Delrin clamp for attachment to the end of an SP Series Post, or the FC-1 may be held by a CA-1, cross-post adaptor.

MORE CLAMPS

These little clamps are useful for fastening things down to the **Newport Isolation Table Tops** when the holes (if any) of the device don't line up with the tapped holes in the table. For instance, if only one of the holes in a **Newport Model 45 Damped Rod** lines up with a table hole when it's placed in a useful position, then added stability and protection against getting bumped out of position is afforded by attaching one of the clamps to the diametrically opposite hole on the **Model 45's** flanged base.

Base Clamps



BC-2

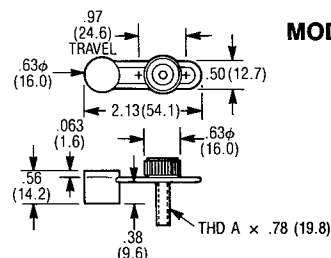


BC-1

Models BC-1 and BC-2 Base Clamps secure components to any surface having 1/4-20 (M6) tapped holes, where direct tiedown is not practical. BC-1 is designed primarily for use with 3/8 in. (9.5 mm) Mini Series Base Plates, while BC-2 is for thicker bases such as the EB-1 Elevating Base. To use, the clamp is positioned so the heavy steel loop is over the base and so the screw can be inserted into a tapped hole. Tightening this screw will generate enough clamping force for most applications. Overtightening will not distort the table skin because the steel loop will deflect first. By inverting the clamp, thin objects can be secured in place. For larger objects, **Models CL-4 or CL-6** (page G-32) are recommended.

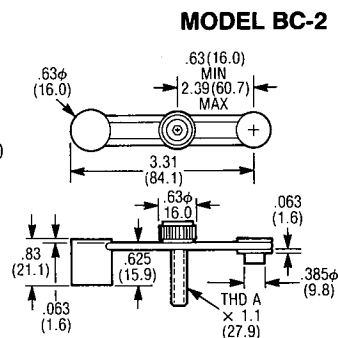
Base Clamps

	English Model	Metric Model
Base Clamp	BC-1 BC-2	M-BC-1 M-BC-2



MODEL BC-1

MODEL	THREAD A
ENGLISH	
BC-1	1/4-20
BC-2	1/4-20
METRIC	
M-BC-1	M6
M-BC-2	M6



MODEL BC-2

Universal Swivel Jaw Extension Clamp



Especially adaptable for use with condensers and irregularly shaped objects. It has an upper swivel jaw, plastisol covered. Another rubber-covered swivel jaw, placed between the clamp arms proper and the shank, permits its orientation at any angle. (Humboldt H-8370)

Jaw Opening To, in.	Overall Length, in.	Cat. No.	Each
2	8 3/4	21571-258	10.90
3	10	21571-305	13.85

This clamp makes a dandy inexpensive **Cylindrical Laser holder**.

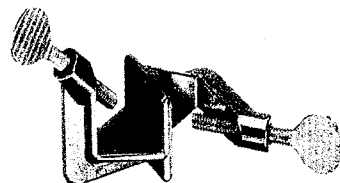
RIGHT ANGLE CLAMPS**VWRbrand® Clamp Holder**

This is made from a non-ferrous, die-cast alloy that will not rust, and is fitted with

aluminum thumbscrews. Takes rods up to 5/8 inch diameter.

21572-501

6.25

VWRbrand® Jumbo Clamp Holder

Designed to hold heavy apparatus such as stirrers, circulating pumps, heaters, etc. Clamping faces have a large surface area to give maximum support.

Jaws grip shelves, bench tops, 3/4" pipe, or support rods up to 1". Made of corrosion-resistant alloy.

21572-556

9.95

Right Angle Clamps are part of the basic building setups, and come from a variety of manufacturers. Some aren't big enough to hold rods > 1/2", others won't screw down enough to hold thin rods, but with the variety we have you should be able to find what you need.

Regular Holder

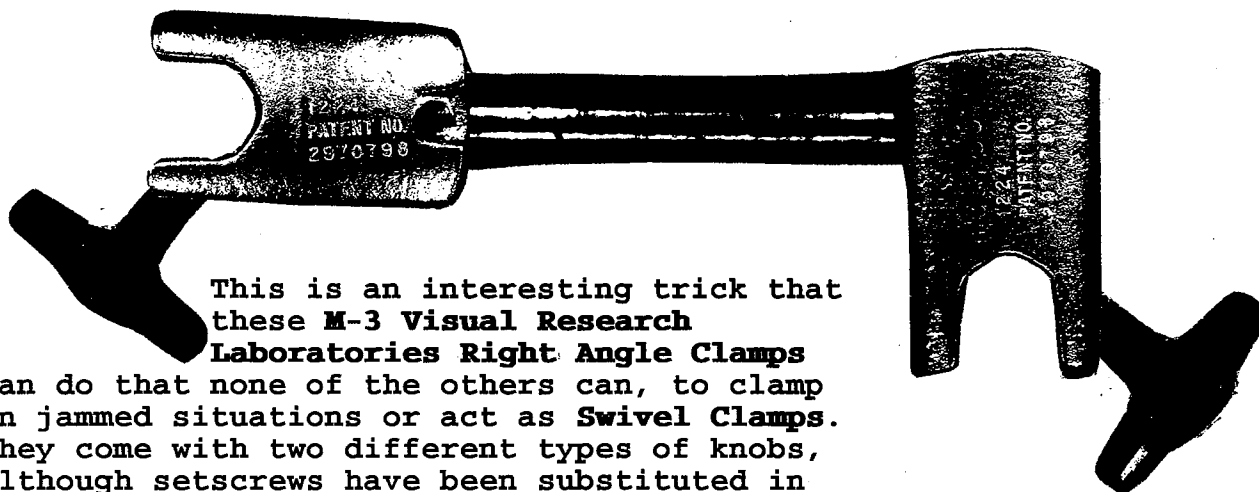
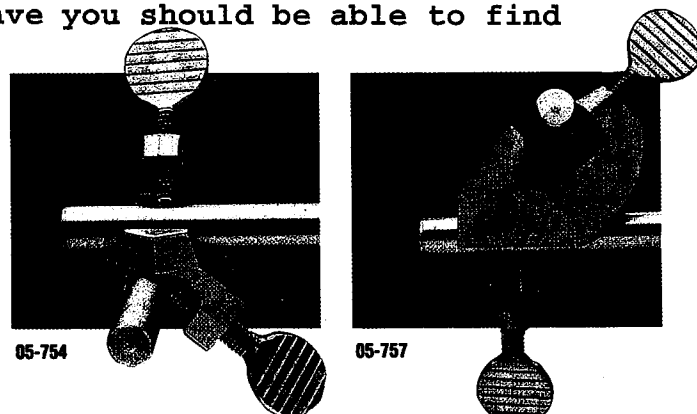
Attaches clamp at right angles.

Max. Rod Grip Size	Cat. No.	Each
3/4" (19mm)	05-754	8.50

Jumbo Holder

Safest for heavy loads. Grips in variety of positions. Also holds flat shelf or panel to 3/4" (19mm) thick.

Max. Rod Grip Size	Cat. No.	Each
7/8" (22mm)	05-757	13.00



This is an interesting trick that these **M-3 Visual Research Laboratories Right Angle Clamps** can do that none of the others can, to clamp in jammed situations or act as **Swivel Clamps**. They come with two different types of knobs, although setscrews have been substituted in certain critical situations that needed to be made tamper-proof.

SWIVEL CLAMPS (For Flexibility in More Than Two Dimensions)

Swivel Clamps are like **Right Angle Clamps** in that they attach two rods together, but the swivel feature allows any arbitrary angle to be formed between the two.

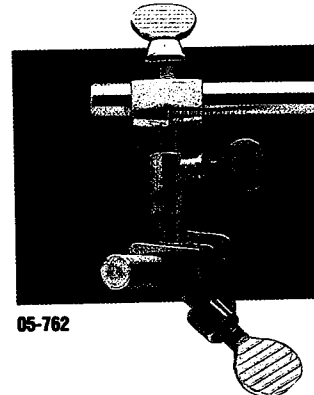
Castaloy Clamp Holders

With 45° Angle Thumbscrews

Swivel Holder

Tilts clamp at any angle in parallel planes. Holder will not fall apart when setscrew is loosened to permit one end to swivel.

Max. Rod Grip Size	Cat. No.	Each
$\frac{3}{4}$ " (19mm)	05-762	12.00



05-762

VWRbrand® Swivel Clamp Holder



For adjustment at any angle. Holder is constructed so that when the set-screw on the angle adjustment is released, the

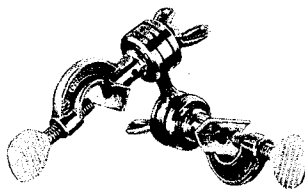
two halves of the holder do not come apart. Takes rods up to $\frac{3}{4}$ inch diameter.

21572-603

10.95

Sometimes referred to as a **"Double Swivel Clamp"** or **"Contort Holder"** this little jobbie has enough flexibility to attach the "tail" of a **Plateholder** or **Large Mirror Mount** to another rod on a **Magnetic Base** for the ultimate in stability.

VWRbrand® All Position Clamp Holder



An all-purpose clamp holder that can be turned through any angle in any plane, has two holding members set at 90° angle, and connected by a double plate

joint. Washers between the flat gripping faces hold the clamp rigid by applying pressure with wing nuts. Takes rods up to $\frac{3}{4}$ inch diameter.

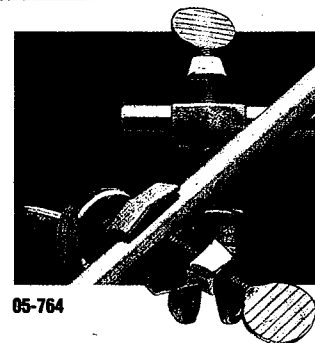
21572-658

19.95

Contort Holder

Connects at any angle in any plane. Consists of two holders connected by double plate-joint which sets holders 90° from each other. Each holder can be rotated 360°.

Max. Rod Grip Size	Cat. No.	Each
$\frac{3}{4}$ " (19mm)	05-764	23.00



05-764

GRASPING CLAMPS

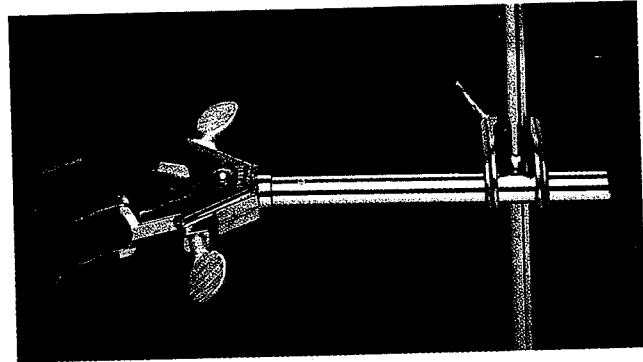
Three-Prong Clamps

Hold irregular shapes at any angle

Hold objects up to 3½" (89mm) surely and safely. Two separate adjustment screws ensure even, precise pressure on glass. Minimize chance of breakage. Clamps are easily adjustable to vary holding angle, distance from stand. Come with both fiberglass and vinyl sleeves.¹ Without clamp holder.

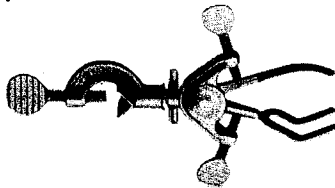
Max. Grip Size	Overall L	Extn. Arm	Extension Rod O.D.	Cat. No.	Each
1" (25mm)	6½" (17cm)	4¼" (11cm)	⅝" (0.8cm)	05-769-6	16.50
2¼ (57)	8¾ (22)	5⅞ (13)	⅞ (1.1)	05-769-7	12.50
3½ (89)	10½ (27)	6 (15)	½ (1.3)	05-769-8	16.50

¹For replacement sleeves, see next page.



Also called **"Three-Finger Clamps"**, they are useful for holding larger objects, like camera objectives.

VWRbrand*
3-Finger Utility Clamp,
Vinylized Jaws



A very popular clamp because of its wide utility. It can be extended in length ⅝" and firmly locked in any position by means of the wing-nut. It will hold objects up to 2¼" in diameter and grip rods up to ¾" diameter.

Cat. No. Each

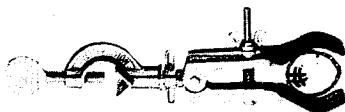
21573-708 13.95

Clamp with Fiberglass Sleeves

Identical to 21573-708, except fiberglass jaw sleeves.

21573-752 12.50

VWRbrand* Small
Utility Clamp, Round
Vinylized Jaws



These all-purpose utility clamps allow easy adjustment of apparatus to any angle. Made of corrosion-resistant PS alloy, with stainless steel springs. Round jaws grip objects up to 1½" diameter. Clamp extends up to ½ inch, rotates 360°, is securely held in any position with lock nut.

Cat. No. Each

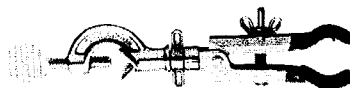
21573-504 11.50

Clamp with Fiberglass Sleeves

Identical to 21573-504, except fiberglass jaw sleeves.

21573-559 12.50

VWRbrand*
Medium Utility Clamp,
Round Vinylized Jaws



Similar to 21573-504, but larger. These clamps may be extended in length up to ¾ inch. Jaws can be securely tightened at any angle and will not swivel under strain. These clamps will grip rods up to ¾" diameter and hold objects up to 2¼" diameter.

Cat. No. Each

21573-606 12.50

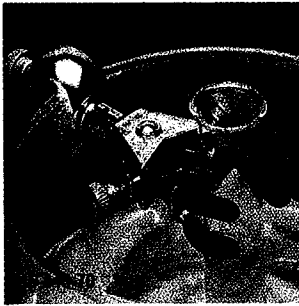
Clamp with Fiberglass Sleeves

Identical to 21573-606, except fiberglass jaw sleeves.

21573-650 12.50

Just like the catalog says, useful for small round objects, like loose lenses.

MISCELLANEOUS CLAMPS



A **Thermometer Clamp** is good for holding glass rods to be used as one-dimensional beam expanders, and it is adjustable rotationally to orient the rod for horizontal or vertical divergence.

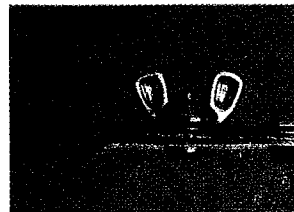
Thermometer Clamps

Hold $\frac{1}{4}$ to $\frac{1}{2}$ " dia. (6 to 13mm) glass tubes and thermometers. Adjust to any angle. Won't rust. Jaws are nickel-plated phosphor-bronze.

Standard clamp. Holds thermometers $3\frac{7}{8}$ " (10cm) from support rod. Integral clamp holder. Large thumbscrew holds clamp securely to support rod.

Extension Clamp. Holds thermometers up to 7" (18cm) from support rod. Overall L, $7\frac{3}{4}$ " (20cm). Extension arm is $\frac{7}{16}$ " dia. (11mm). Use with 05-754 clamp holder on p. 491.

Clamp Type	Cat. No.	Each
Standard	05-809	12.50
Extension	05-809-10	12.50



Clothespins are useful for hanging film up to dry. They are found in the **Film Drying Cabinet** or hanging on a wire over the **Darkroom Sink**.



We have some big **C-Clamps**, useful for attaching big things together, like **Drill Press Vices** onto table tops for displaying holograms. Please return them to their **Storage Place** on the **West Wall of the PRINTER ROOM**.

t information.

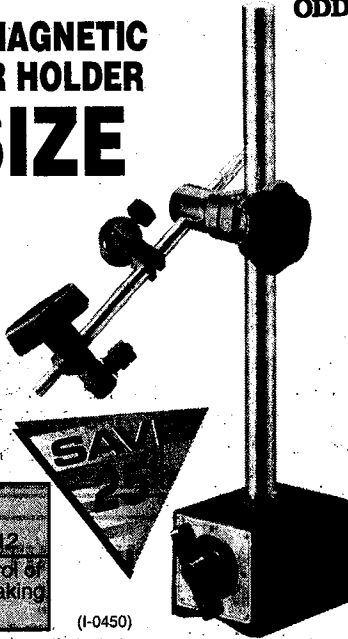


Enco ON-OFF MAGNETIC BASE INDICATOR HOLDER KING SIZE

- Powerful 175 lb. pull.
- 14" tall.
- 8" 3-diameter fine adjustment rod.

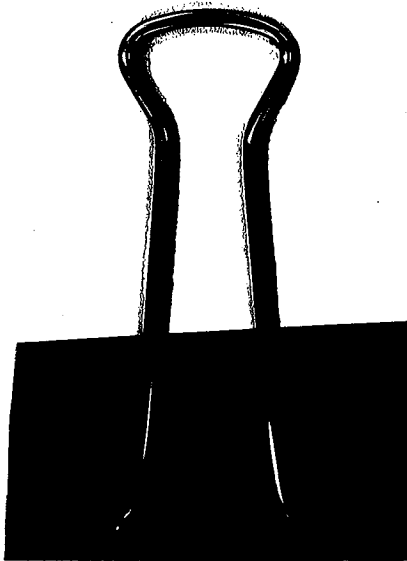
MODEL 625-0360
List Price \$66.03
YOUR COST
\$49.99

EXCLUSIVE
Fine Adjustment
U.S. Patent No. 3367612
Gives rigid sensitive control of
indicator on any plane, making
difficult setups easy.



(I-0450)

Drill Press Vices are handy
for holding Objects in the
**ONE-STEP RAINBOW SHADOWGRAM
SET-UP.**



ODDBALL CLAMPS

In a bin to the left of the
big bin of clamps are
contained the clamps and rods
that came with **Enco Model 625-
0340 ON-OFF MAGNETIC BASE
INDICATOR HOLDERS.** (See the
Handout, **MAGNETIC BASES.**) The
pieces, if you can figure them
out, can come in quite handy,
as evidenced by the ingenious
cylindrical lens holder the **ONE
STEP RAINBOW SHADOWGRAM.**



(K-0039)

Enco HORIZONTAL/VERTICAL DRILL PRESS VISES

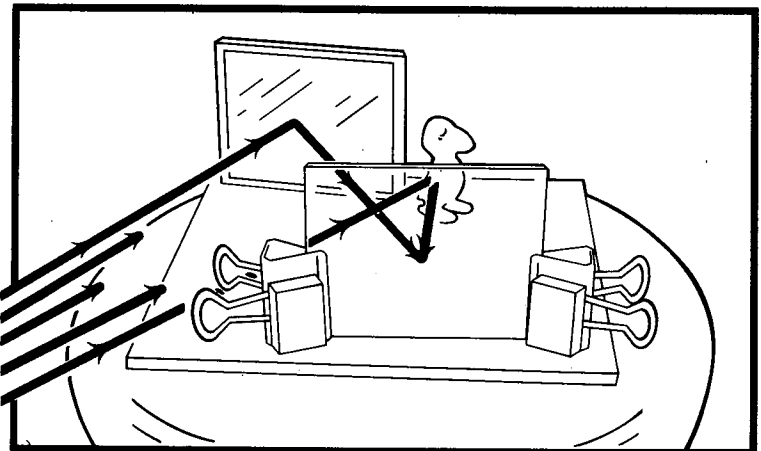
3" MODEL 426-8050
YOUR COST
\$10.50

* Horizontal Only

Fast Position Hinged Handle

- High tensile
Iron casting.
- Steel jaws.
- Ground bases
for use
horizontal or
vertical.

Jaw Width	Base Length	Base Width	MODEL	YOUR COST	WT. Lbs.
3"	6.4"	5.5"	426-8050*	\$10.50	5.12
4"	7.8"	7"	426-8055	13.50	5.74
5"	8.5"	7.5"	426-8060	22.75	10.26
5.875"	9.750"	8.6"	426-8065	29.18	13.44

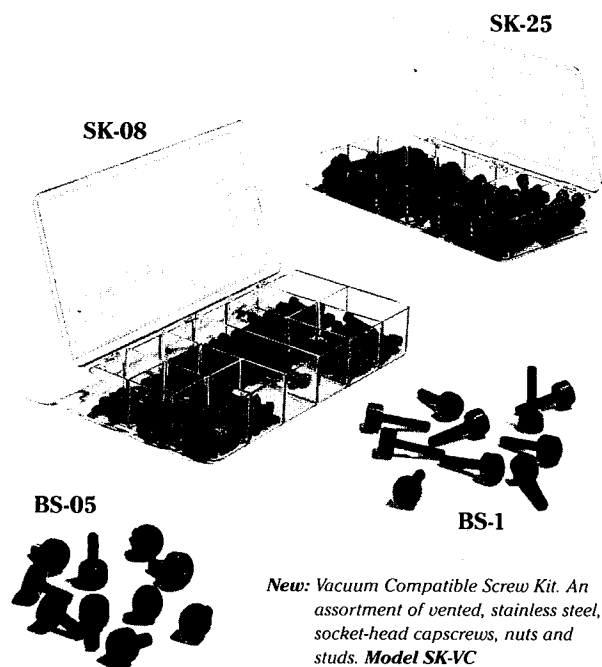


The venerable **Bulldog Clamp** can be pressed into service as a
quick and dirty **Holographic Plateholder** with a bunch of **Magnets**
or **Magnetic Bases.**

SCREW KITS

We have three of the **English Kits**, stored in the **PRINTER ROOM** on the middle shelf along the West wall. Besides the Newport contents, various small **Allen Head Cap Screws**, **Set Screws**, and **Newport Model BC-2 Base Clamps** are stored in them. Whenever you find small, important looking nuts and bolts, please deposit them in here, so that the minimal amount of time can be spent looking for that one special something.

Screw Kits



These kits are convenient assortments of the most-needed socket-head capscrews and thumbscrews for the laser/optical laboratory. **SK Series Kits** contain an assortment of corrosion-resistant black-oxide coated screws, studs, washers and nuts, conveniently stored in a durable, clear plastic case. Four kits are available consisting of hardware for 1/4-20 or 8-32 English threads or M4 or M6 metric threads. **BS Series Kits** feature ten 1/4-20 or M6 socket-head thumb-screws of the type used in **Mini Series** bases.

Screw Kits

English Kit	Thread	Metric Kit	Thread
SK-08	8-32	M-SK-M4	M4
SK-25	1/4-20	M-SK-M6	M6
BS-05	1/4-20	M-BS-05	M6
BS-1	1/4-20	M-BS-1	M6

Contents

Socket-Head Capscrew Kits:

SK-08 (M-SK-M4):

Qty	Length
15	.375 in. (10 mm)
15	.500 in. (12 mm)
15	.625 in. (16 mm)
15	.750 in. (20 mm)
12	1.000 in. (25 mm)
12	1.250 in. (30 mm)
12	1.500 in. (40 mm)
12	1.750 in. (45 mm)
12	2.000 in. (50 mm)
18 Socket-head Studs	.625 in. (16 mm)
18 Nuts	
25 Flat Washers	

SK-25 (M-SK-M6):

Qty	Length
15	.375 in. (10 mm)
15	.500 in. (12 mm)
15	.625 in. (16 mm)
15	.750 in. (20 mm)
12	1.000 in. (25 mm)
12	1.250 in. (30 mm)
12	1.500 in. (40 mm)
12	1.750 in. (45 mm)
12	2.000 in. (50 mm)
18 Socket-head Studs	.625 in. (16 mm)
18 Nuts	
25 Flat Washers	

Socket-Head Thumbscrew Kits:

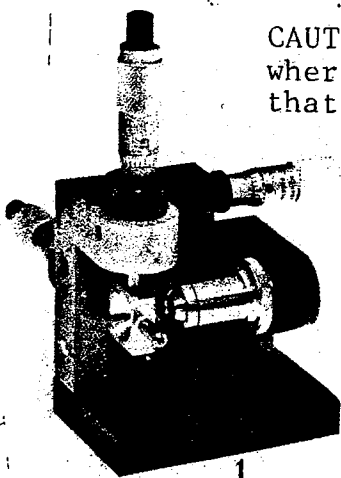
BS-05 (M-BS-05):

Qty	Length
10	0.75 in. (20 mm)

BS-1 (M-BS-1):

Qty	Length
10	1.25 in. (30 mm)

SPATIAL FILTER BEAMSPREADER



CAUTION!! This adjuster exhibits "Lefty's Revenge", wherein the movement of the objective is contrary to that established by the right hand rule of thumb!

Alignment

Aligning Model 900 is straightforward. Position the spatial filter assembly in the laser beam while observing back reflections from the microscope objective to bring them into best coincidence with the input laser beam. Next, align the pinhole: (1) defocus the lens; (2) while observing the pinhole substrate, adjust the pinhole position until a faint light appears at the output; (3) alternate the lens Z-axis adjustment with pinhole position corrections until the best throughput and focus are achieved. This is indicated when a deliberate pinhole shift causes the symmetric output pattern to disappear. A slow smear means a poor focus.

Fits on special carriage for the damped rods.



Pinhole/Objective Selection Guide

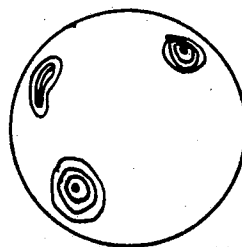
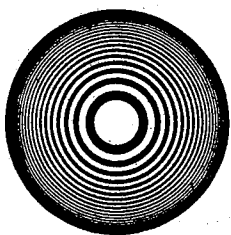
Objective	Recommended Max. Input Beam Diameter (mm)	Calc. Pinhole Dia.* (micron)	Recommended Pinhole Dia. (micron)
M-5X	5	32.3	50
M-10X	5.5	18.7	25
M-20X	5	10.5	15
M-40X	4	5.4	10
M-60X	3.5	3.7	5

*For 1 mm Diameter Beam at 633 nm; see Optics Tutorial

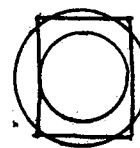
Although these are recommended, they are just starting points. You may have to try different pinholes to get the best tune.

Pinhole too small: will never get rid of rings.

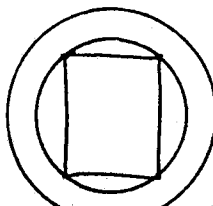
Pinhole too big: some noise will squeak through.



CHOICE OF OBJECTIVE: Whichever one fills the entire plate or object with the hot center of the Gaussian beam profile. The higher the "X number" the wider or faster the spread. Inserting a weak diverging lens (-20 to -40 focal length) before the objective allows you to zoom the spread.



TOO SMALL



JUST RIGHT!

EW 1/29/89

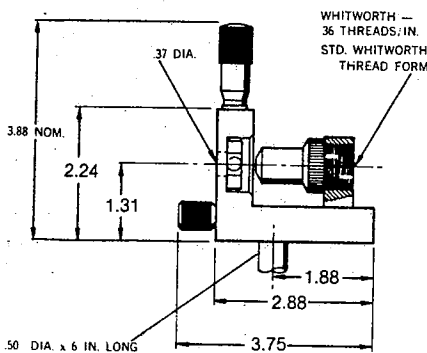
Lens Pinhole Spatial Filter: LPSF-100

The LPSF-100 spatial filter is a compact, versatile instrument designed especially for holography and optical data processing.

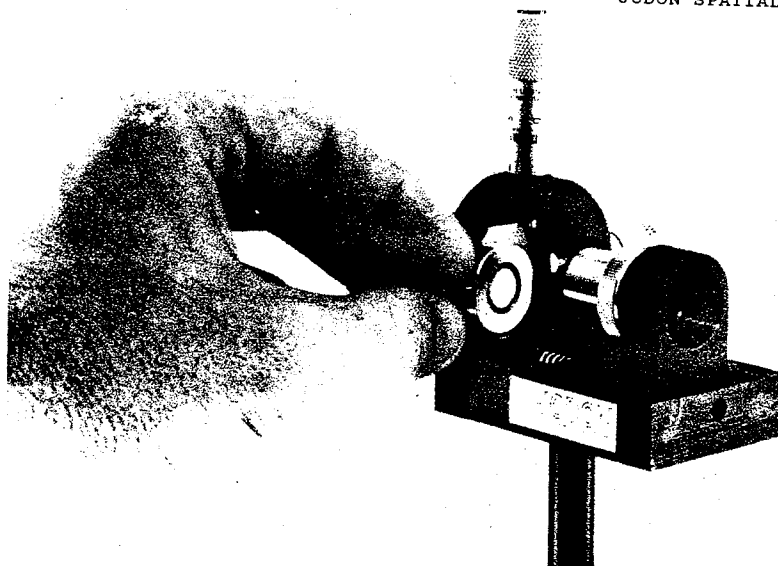
The instrument consists of a pinhole movable along with X and Y axes and a standard microscope objective movable along the Z axis. The pinhole is made of electroformed nickel mounted in a 0.875-inch diameter ring magnet. Precision micrometer screws glide the magnet on a Teflon® pad along the X and Y axes. Smooth movement along all three axes leaves no detachable lash or sideplay. Also, the sensitivity of the mechanism enables you to use pinholes as small as 5 microns and microscope objectives as large as 60X.

The easily removable, magnetic-pinhole assembly characterizes the versatility of the instrument. This removable assembly enables you to arrange the subject and reference beams of a holographic system, or the optical axis of an optical data processing system, before you insert and adjust the pinhole. You can also quickly change the pinhole size to produce the required degree of filtering simply by sliding a different pinhole into place.

Set-up time, from total nonalignment to alignment, is typically less than 2 minutes. After you align the filter, you can remove and reinstall any magnetic-pinhole unit without adjusting the axis controls.



Teflon® is a registered trademark of E. I. DuPont de Nemours and Co. Inc.



The Jodon Lens Pinhole Spatial Filter Model LPSF-100 has a major improvement over the Newport Model 900 Spatial Filter in the pinhole holding department. Instead of limply holding the Pinhole Mount with weakly magnetized Micrometer Knobs, the mount of the Jodon is itself magnetic, and slides on a Teflon-coated steel washer.

The problem with the stock Jodon is that the Objective may be screwed in too close to the Pinhole Foil during the heat of alignment and crush it in a vice-like grip*. We have modified the unit by reversing the Pinhole Positioning Plate so that when the Objective contacts the Pinhole it will push it out and not pinch it.

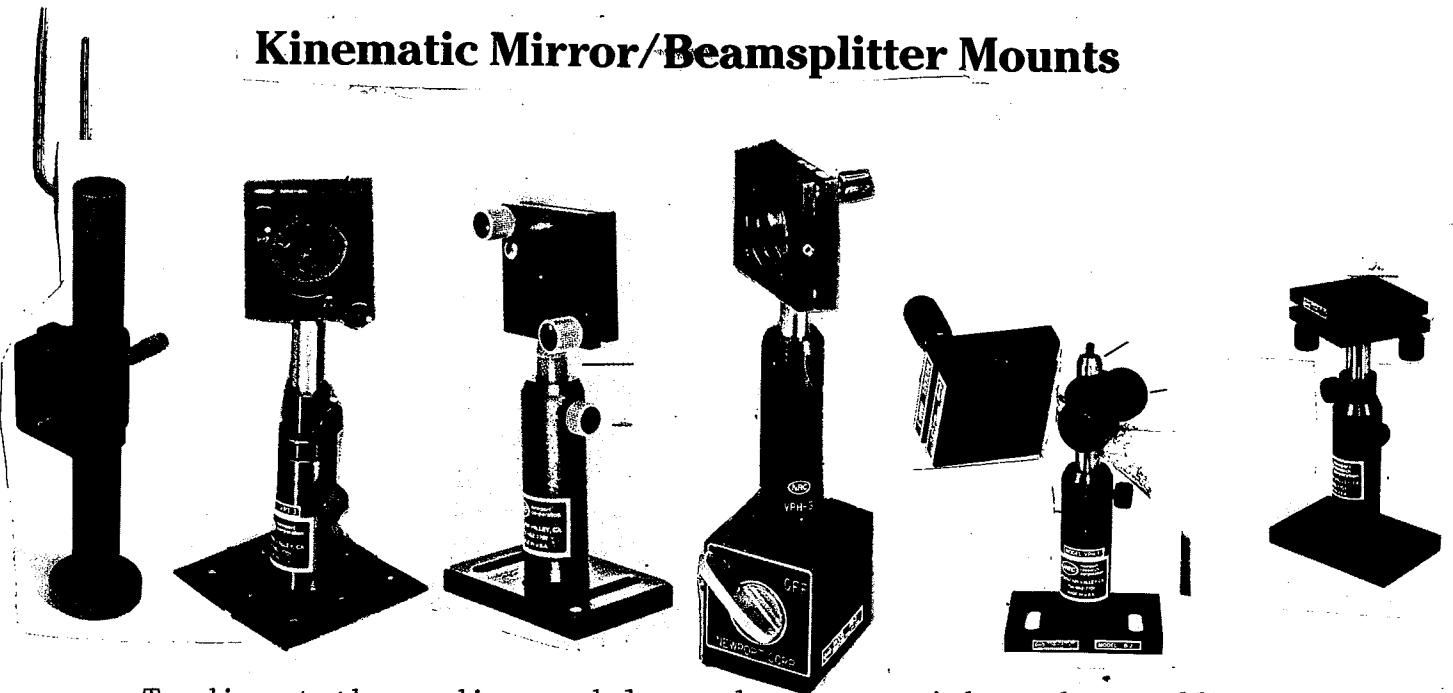
CAUTION! Some Pinhole Mounts may not have any handles! Orient the Mount with the round side down, with the Pinhole Foil towards the Microscope Objective.

TO TUNE: Look back toward the Pinhole, off its axis, and alternately manipulate the Horizontal and Vertical Control Knobs until maximum brightness is obtained. Pick a direction to turn the Microscope Objective Focussing Knob on the front of the unit, and work the Pinhole Knobs again. If the spot is brighter, continue turning the Focus in the same direction until there is enough light leaking through to be seen on a card. Otherwise reverse direction to get to the desired effect.

Currently these units run for \$725. They could save us some money by not rounding all the corners for styling, because big square blocks, which the round ones were machined out of, block much more stray light.

* As opposed to the Newports, whose Pinholes drop to the table top when the Microscope Objective contacts the Mount.

Kinematic Mirror/Beamsplitter Mounts

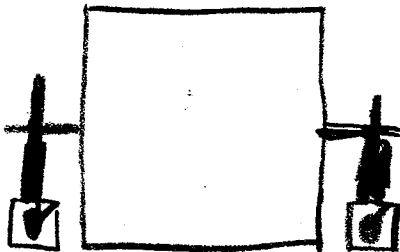


To direct the undiverged laser beam use either the small mirrors mounted on the large rods or small rod-mounted mirrors in whatever configuration seems appropriate. After placing the mirror in position use a yardstick to make sure the beam is traveling parallel to the table top. The small mirrors have the advantage of being able to send the beam upward or downward when used with a right angle clamp.

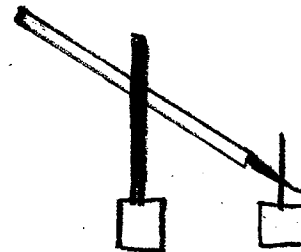
If the mirror mount feels loose, use a different one. Sometimes these units will "drift" out of position overnight. Find the offending item and retune.

FOR BIG MIRRORS

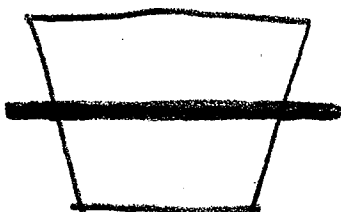
Use two magnetic bases as "goalposts" and support the mirror between them.



Mirror glued onto wood or plastic threaded for rods.



When mirror is high off table use third rod, clamp and base to stabilize it so that the angle doesn't shift!



Intermediate-sized mirrors can be glued directly onto long rods.

EW 1/29/89

FILM AND PLATEHOLDERS

It is the job of these pieces of equipment to hold your holographic recording materials in position stably, without letting the material move in any way. Although this piece is the last component that the laser light hits, it should be first in your consideration in laying out a holographic set up. Because this is where all the interference action takes place, it deserves the utmost in stability. Going the lowest center of gravity route by letting it rest on the table, or by straddling the magnetic bases in a goalpost situation, is the optimum, and if it is necessary to support it above the tabletop a tail should be used just like in "LARGE MIRROR MOUNTS" to stabilize it. The center of the plate then determines the beam's height above the table.

Holding a holographic plate for reflection holography means grasping it around the edges, and stability is ensured by the glass substrate. Plastic based film is always moving if care is not taken to stop it. Many different approaches have been taken to hold film steady during reflection hologram recording, mainly the use of clear glass plate sandwiches, with or without index-matching fluids, however they are not 100% successful. There is inevitably a black area on the hologram caused by the film itself moving locally during the exposure, brought on by pockets of air trapped in the sandwich. If there is a need for many copies of the same reflection hologram, it is best to make a good glass plate and then make contact copies on the cheaper plastic, as shown in the handout, "IMAGE PLANE SBR".

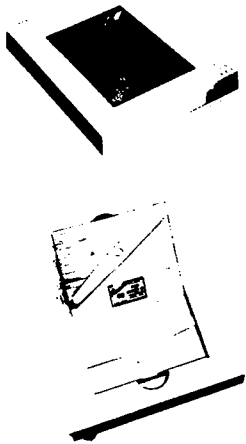
The air pockets occur in the center, not at the edges, where there is the clamping tension. But for transmission holograms, where there is no need for the light-sensitive coating to be accessed from both sides, a filmholder can be designed so that pressure can be applied evenly to the whole of the film and not just at the edges. Vacuum frames, water-soluble adhesives, or electrostatics have been tried, but what is in use here at the SAIC are contact print frames.

WOODEN FRAMES: There are several different sizes of holders that are modelled on the traditional contact copying print frames from photography. Some are of photographic grade, but the heavy duty ones were made here in the woodshop by Dean Randazzo. They are commonly used for holding film or plates in transmission hologram set ups because of the backing plate, but they have been used for contact printing reflection holograms onto film in a Single Beam style. There are tee nuts with threads for attaching rods to them on either side for horizontal or

Professional
Print Frame

Spring steel clamps insure perfect contact. All metal parts heavily plated. Laminated pressure back lined with felt. Frame glass furnished. Frame made from select pine — painted black.

Model	Sizes
PF8	8 x 10"
PF11	11 x 14"
PF16	16 x 20"



vertical formats. There are velcro loops on the filmholders so that mirror covers can be used to shield live film in the holder while masters or slits are changed in Transfer or One Step Rainbow Set Ups. We have this type in sizes from 3 1/4" by 4", 5" by 7", (no 4" by 5" but if anyone finds one...), 8" by 10", 30 by 40 centimeters, 16" by 20", and 50 by 60 cm.

A complete set of components for holding film includes not only the film (or plate) holder but also the following accessories:

CLEAR FRONT GLASS	BLACK CLEAR GLASS
BACKING PLATE WITH SPRINGS	GNOMON ANGLE FINDER
WHITE LINE UP CARD	QUADRANT EXPOSURE TESTER
GROUND GLASS FOR FOCUSING REAL IMAGES	

A film sandwich is made with the clear glass in front, the film, and the black glass with the paint away from the film! Look at the difference between the painted and unpainted sides; the former acts as a weak diffuse reflector, while the other side looks very black because all the light is specularly reflected off in a certain direction. You can of course find the specular reflection by following angle of incidence = angle of reflection law, but nobody would look at a hologram like that because they would get the specular reflection of the reference beam into their eyes! If the painted side were toward the film, its non-uniform thickness would not hold the film very flat, causing motion pockets in some areas and Single Beam Reflection holograms of the specular highlights to mar others.

Elimination of pockets of air trapped in the film-glass sandwich is effected by placing the sandwich on a flat table top with a clean Photo-Wipe on it, and pressing down on it using the back plate from the Plateholder to squeeze the air out. If done well, it is very difficult to separate the two plates by any other way except by sliding the pieces across each other. The force of the air pressure of the atmosphere against the two pieces of glass keeps them in intimate contact. It is not unlike "wringing" out the air between two Gage Blocks in a machine shop.

Always use an insulating object to do the squeezing, not the direct pressure of hands, because they will heat up the glass and you may have to wait a very long time, like tens of minutes, for it to cool off and settle down. For the same reason it is best to handle the sandwich as delicately as possible when loading it into the plateholder, or with cotton gloves.

Usually the emulsion side of the film is placed outwards, towards the object or master, but it doesn't really matter all that much. Sometimes there may be a need for the emulsion to be in a certain orientation when the final holographic display is framed, so plan ahead and think backwards to determine the true orientation!

The film holders can of course be used to hold holographic plates instead of film sandwiches. The best way to avoid making a Single Beam Reflection hologram of the back pressure plate in this case is to pre-coat the back of the plate with some #33 Antihalation Spray. Putting some black paper or cloth behind it still makes a hologram, but the light returned from the back of the plate will be minimized. Sometimes you might

find an interesting Single Beam Reflection hologram of the backing, with bright patterns alternating with dark pockets of movement of the backing material.

BIG NEWPORT PLATE HOLDERS: We have two each of each of the sizes of these pieces of junk. (I didn't order them!) Although they could probably be run over by a tank without losing their ability to function, they have serious design flaws that make them almost totally unacceptable for display holography.

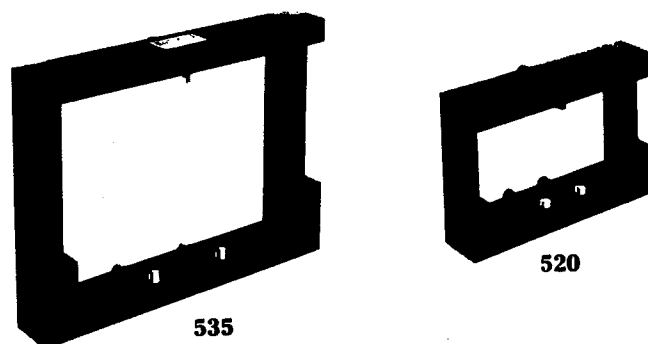
First off, they are designed to accept reference beams coming from the long side of the plates, as there is a severe overhang that casts a major shadow when the reference beam comes parallel to the short side, making the usable holographic area smaller than the nominal plate size. Another design defect is in the spring loaded clamps whose chrome-plated dowel pins always come out in the hologram, necessitating cropping again.

They were provided with milled slots for attaching to the table with the long side down. We have modified these things so that they can be attached to the table on the short side, or attached to magnetic bases, or supported between a pair of "goalposts".

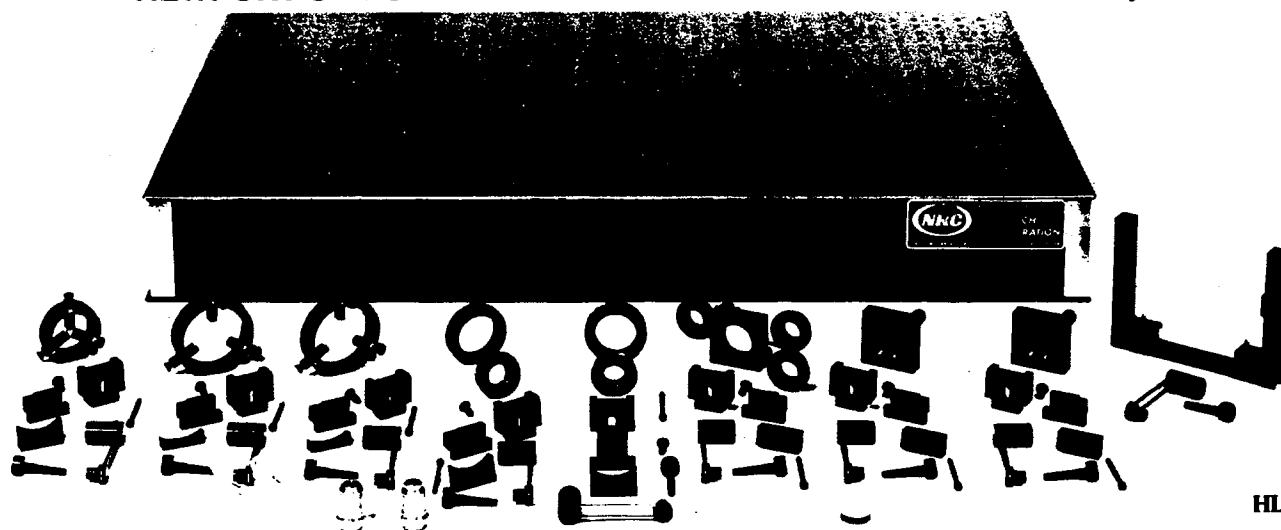
They are not totally useless, as they could be used as master holders for rainbow transfers, or plate holders for two beam reflection holograms if you can tolerate the loss of usable area. They have been used successfully in holding film sandwiches in reflection holography.

Film Plate Holders

Model 520 and 535 Film Plate Holders have identical plate holding mechanisms that incorporate three spring-loaded movable pins, one on the top and two on the bottom, to hold the film plate against matching reference pins. Model 520 can handle plates up to 5 in. (127 mm) wide, and Model 535 can handle plates up to 10 in. (254 mm) wide. Made of heavy black-anodized aluminum with stainless fittings, the holder is rugged and can be tied down to a Newport table using three 1/4 in. (6 mm) clearance holes. For applications requiring precise micropositioning of the film plate to a specific location, Model 520 can be mounted on the **Model 525A Micropositioning Base**.



NEWPORT'S BEST FOUR BY FIVE INCH PLATEHOLDER is actually based on



a JODON design, which is very good, but NEWPORT refuses to sell it separate from their silly Tinkertoy "HOLOGRAPHY LABS" HL-1 and HL-1a (pictured). Which is to their disadvantage, as it would easily outsell the clunky and virtually useless Film Plate Holder 520. The CNC milled U-shape has a convenient notch cut into it for fingers loading plates. Its dimensions have been engineered to provide an offset so that when the holder is removed from the support post and reconfigured from a horizontal composition to a vertical one the center of the plate remains at the exact same position with respect to the incident laser beams.

This plateholder is part of an assembly that includes a GAERTNER Magnetic Base, a NEWPORT Base B-2, a NEWPORT Post Holder VPH-3, and a NEWPORT Support Post SP-2. The latter is jammed very tightly into the Post Holder, and is set so that the center of the four by five inch plate, in either horizontal or vertical orientation is at the height of the Cylindrical Laser on the Beginning Table. Please don't do anybody a favor by changing this base assembly. If you need the Plateholder, and at a different height, scrounge up some other parts for fixturing.

The plate is held in its plane by three panhead Allen head bolts. These do such a good job of locating that you can many times replace the plate right back into the holder after processing and observe "REAL TIME INTERFEROMETRIC FRINGES" on the object by having the stored holographic image interfere with the actual object's wavefront.

BLADEHOLDER: This plateholder has its roots in holding electronic circuit board during their assembly. Stability is not of great concern in this application, so it takes a bit of gentle persuasion and tender alignment to get this unit to hold the holographic plate so that it is not loose in the mount, but also not so tight that it distorts the plate, causing it to bow during exposure. If a hologram subjected to this stress comes out at all, it usually has bands across it. It is a good idea to practice loading a dud plate into it with the room lights on to get the feel for it.

TO SET BOTH BLADES PARALLEL: Set the blades on a tabletop. Loosen one so that it falls onto the same plane as the other.

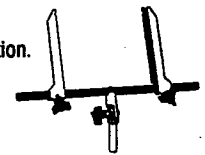
We also have the PANAVISE BASE that came with the holder, and it may have some applications not necessarily in the recording of holograms but elsewhere in the studio.

JUMBO PLATEHOLDER: This unit was machined here many years ago by an alumnus, Steve Wolf, and it is a great design. It is useful for holding 30 by 40 centimeter masters in transfer set ups, or the copy plate in a large reflection transfer. Unfortunately it can be used in only one orientation, but it works very well in this manner.

MODEL 315 CIRCUIT BOARD HOLDER

The Model 315 holds circuit board of any shape in any position. Crossbar holds p.c. boards up to 8". A second set of "V" grooves is positioned laterally near the tip of the arms to facilitate holding small p.c. boards and electronic parts.

No. 620P0028 \$25.95

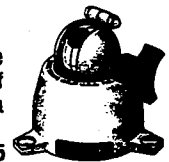


All Prices Subject to Change F.O.B. Plymouth Meeting

MODEL 300 STD. PANAVISE BASE

Holds all PanaVise Heads and p.c. board holders. The variable load control knob and exclusive splitball feature have a range of tension which permits moving work to any position. Then, a slight additional turn locks the head firmly in place.

No. 620P0010 \$18.95



The glass is held by two bars whose pressure is adjusted by the bolts on either side. It is heavy and sturdy enough to stand on its own, but to take no chances attach it to the table with the Newport Base Clamps BC-2. The top of it may have a tendency to flap in the breeze a bit, so add a rod and clamp and magnetic base to the side to stabilize the summit.

There are other ways of holding plates during the recording of a hologram, especially in Single Beam Reflection style, by laying the plate on the object itself, either by a clever design of the object or with three screws or bolts screwed into a NEWPORT Table top or a piece of wood with the object laying on its back. The key to success is three point support! Also watch out for light entering the thin edge of the plate, and bouncing around inside it, causing those colorful but pesky strips along the plate edge.

STORAGE: There are certain places for the holders to be stored when not in use. The small WOODEN FRAMES, up to 8 by 10 inches, go on the CONCRETE BLOCK SHELVES, along with the NEWPORT PLATE HOLDERS. The larger WOODEN FRAMES, 30 by 40 cm, go in the LARGE WOODEN CABINET. See also the handout, "STORAGE MAP", for more details.

THE LITTLE JOKERS

Normally the Wright Brothers used typical turn of the century engineering prose to describe equipment on their flying machines. However, investigating the cause of the lack of thrust in a 1905 Flyer, they suspected that the propellers were flexing.

"To test this assumption, they mounted the equivalent of a small elevator surface behind each propeller blade. They called these small elevator surfaces 'little jokers.' ... the little jokers did indeed indicate that the loss of thrust was caused by bending of the thin propeller blades in flight."¹

Impressed by this playful philology and for want of a better word myself, I have christened an assembly made up from a **Newport Model No. 110 Magnetic Base*** capped with a **Newport Model PH-4 Post Holder** holding a **3 inch long 1/2" Diameter Metal Rod** screwed into a **Daedal Model 5700 Mirror Mount**** which has hot-glued to it an **Edmund Stock #40,403 First Surface Mirror, 127 x 178 mm (5" by 7")** as the **Little Jokers** for SAIC Holographic Studio purposes.

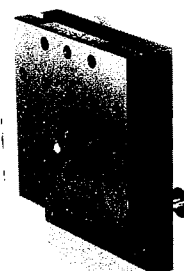
The gross vertical position is adjusted by sliding the **3 inch long 1/2" Diameter Metal Rod** up and down

*. These bases are supposed to have a "Standard kinematic top plate for repeatable positioning" but to show how much we appreciate this feature we have screwed the kinematic tops down onto the mag base so you don't have to worry about the top falling off when picking the assembly up.

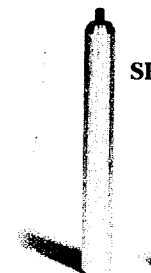
** . The **Daedal Mirror Mount** has a 5/16" threaded attachment hole, in the center of one side on the non-moving back panel, flanked by a pair of 1/4-20 threaded holes. We don't have a 1/2" diameter rod with the 5/16" male thread at the end to screw into the stablest hole position. But neither does **Daedal**, which I found out much to my chagrin when I tried to order one from them. It is a sorry commentary on the state of American industry if a supposedly high tech company produces equipment without regard for mating parts. The solution was of course to drill and tap our own threaded holes on 2 of the **Daedal's** sides, so that the mirrors may be used either horizontally or vertically, which of course wasn't designed into them from the start.

Model X5700 Sale Price \$50

4.5" square plane mount (Same as standard catalog model 5700 except the mounting holes are 10-32 on 0.62" centers.)

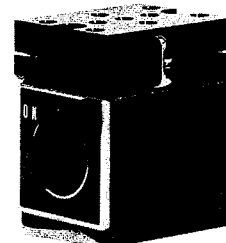


SP-4



VPH-3

110



in the **Newport Model PH-4 Post Holder** and held by tightening the screw knob on the side of the **Newport Model PH-4 Post Holder**. Horizontal and Vertical orientation are adjusted using the finely threaded screws on the back of the **Daedal**.

There are enough pieces to make a matched pair of the "**Little Jokers**" and they should be left assembled for spontaneous use, and stored on the shelf in the **EXPERIMENTAL HOLOGRAPHY STUDIO**. Handle the units only by the **Magnetic Base** or the **Post Holder** to prevent fingerprints from appearing on the **First Surface Mirror**.

They are useful for several things:

As the **Reference Beam Mirror** in the **SINGLE BEAM TRANSMISSION WITH MIRROR MASTER HOLOGRAM SET UP**²;

The two of them placed side by side can generate fringe patterns suitable for **LOW FREQUENCY DIFFRACTION GRATINGS**³;

The pair placed on either side of the **Groundglass** in the **HOLOGRAPHIC STEREOGRAM PRINTER** when it is used in the **ONE STEP RAINBOW SHADOWGRAM CONFIGURATION**⁴ to "extend the width" of the slit.

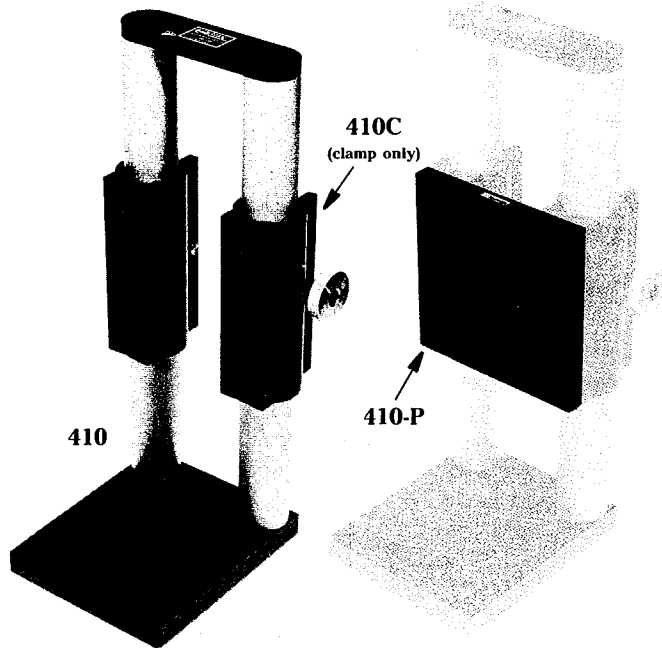
REFERENCES

1. Wilbur and Orville, A Biography of the Wright Brothers, Fred Howard, Ballantine Books, New York, 1987, p.169. I can just imagine Wilbur telling Orville to "Check the trim on the little jokers."
2. See the HANDOUT, **SINGLE BEAM TRANSMISSION WITH MIRROR MASTER HOLOGRAM SET UP**.
3. See the HANDOUT, **HOLOGRAPHIC DIFFRACTION GRATINGS**.
4. See the HANDOUT, **HOLOGRAPHIC STEREOGRAM PRINTER** used in the **ONE STEP RAINBOW SHADOWGRAM CONFIGURATION**.

HEAVY-DUTY OBJECT HOLDER

This thing is extremely heavy duty and its primary purpose here is to fixture objects on the **HOLOGRAPHIC STEREOGRAM PRINTER** when it is used in its object rendering mode, (See the Handout,

Vertical Height Mounting Assembly

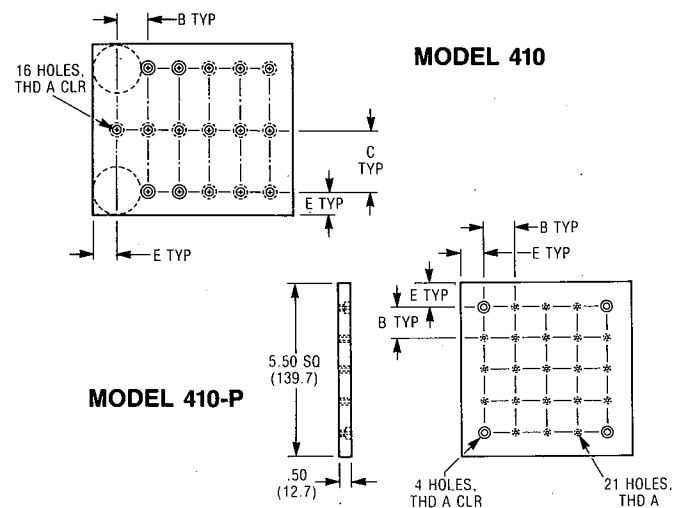
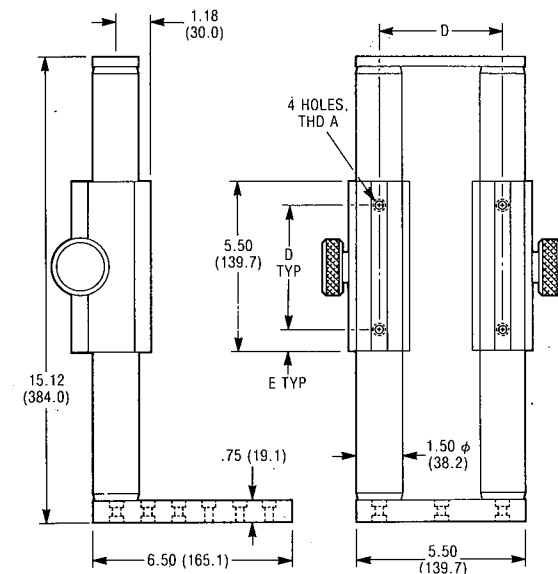


• Dual-rod design provides stiffness and stability

The **Model 410 Mounting Assembly** positions heavy optical components and assemblies at various elevations with excellent stability. The assembly consists of two 1.5 in. (38 mm) diameter solid steel rods attached to a heavy-duty base and connected together at the top, with an extra-long rod-clamp, **Model 410C**, on each rod. These clamps have three line-contact pads over the full length of their bore to ensure stable mounting of components. Components can be attached directly to the clamps, or for more versatile mounting of components, the optional **Model 410-P Mounting Plate** features a standard pattern of tapped holes for mounting virtually any component.

Vertical Height Mounting Assembly

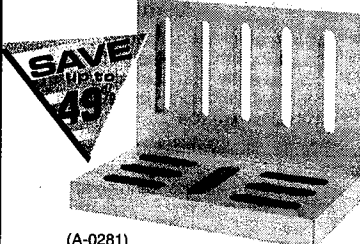
	English Model	Metric Model
Vertical Height Mounting Assembly	410	M-410
Clamp Only	410C	M-410C
Mounting Plate	410-P	M-410-P



MODEL	THREAD A	B	DIMENSION C	D	E
ENGLISH					
410	1/4-20	1.000	2.000	4.000	.75
410-P	1/4-20	1.000	2.000	4.000	.75
METRIC					
M-410	M6	25.0	50.0	100.0	19.9
M-410-P	M6	25.0	50.0	100.0	19.9

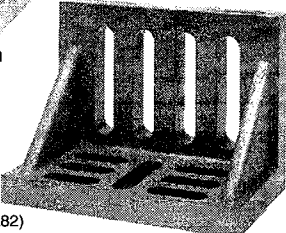
CONVERTING THE HOLOGRAPHIC STEREOGRAM PRINTER TO MAKE HOLOGRAMS OF DIFFUSELY REFLECTING OBJECTS) or on the **EXPERIMENTAL TABLE** to do the same thing in the **SINGLE BEAM TRANSMISSION MASTER HOLOGRAM WITH MIRROR** set up. The **Model 410-P Mounting Plate** is attached to the **Model 410C Clamps**, and an **Enco Model 418-4525 Ground Open End Slotted Angle Plate** provides a convenient base for the object to be holographed. Although heavy and stable, (Guess its weight!* Answer below.) it is a good idea to attach the **Model 410** to the **Tabletop** with screws or **Newport Model BC-2 Base Clamps**.

TO USE, attach the **Object** to the **Holder** and loosen the knobs on the **Model 410-C Clamps** until the **Object** is at the right height from the vantage point of the **Holographic Plateholder**. Move the whole unit to get the **Object** centered horizontally and positioned longitudinally.



Enco SLOTTED ANGLE PLATES

Many sizes also stocked with precision ground finish. Prices on request.



(A-0281)

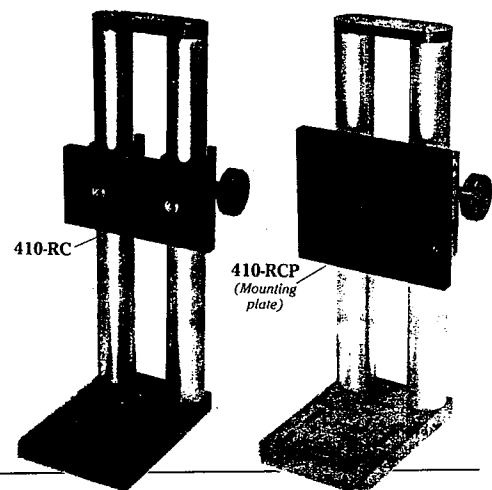
- Made of high tensile cast iron properly seasoned against distortion.
- Webbed style accurately machined, square & parallel on outside faces & ends.
- Open end style accurately machined square and parallel on all faces.

(A-0282)

Approx. Dimensions			Webbed			Open End		
L	H	D	MODEL	YOUR COST	WT. Lbs.	MODEL	YOUR COST	WT. Lbs.
3"	2-1/2"	2"	418-4510 Machined	\$10.95	1			
			418-4612 Ground	14.99	1			
3-1/2"	3"	2-1/2"	418-4515 Machined	12.99	3			
			418-4617 Ground	13.99	2			
4-1/2"	3-1/2"	3"	418-4520 Machined	16.50	4	418-4720 Machined	\$17.99	3
			418-4622 Ground	18.99	7	418-4822 Ground	19.99	3
6"	5"	4-1/2"	418-4525 Machined	22.00	8	418-4725 Machined	25.99	8
			418-4627 Ground	19.99	8	418-4827 Ground	32.99	8
7"	5-1/2"	4-1/2"	418-4530 Machined	23.50	12	418-4730 Machined	29.99	13
			418-4632 Ground	25.99	11	418-4832 Ground	36.99	10
8"	6"	5"	418-4535 Machined	35.60	15	418-4735 Machined	39.99	17
			418-4637 Ground	29.99	15	418-4837 Ground	50.99	16
9"	7"	6"	418-4540 Machined	45.50	24	418-4740 Machined	49.99	22
			418-4642 Ground	36.99	22	418-4842 Ground	58.00	22
10"	8"	6"	418-4545 Machined	45.00	28	418-4745 Machined	59.99	26
			418-4647 Ground	48.99	27	418-4847 Ground	72.99	28
12"	9"	8"	418-4550 Machined	59.95	48	418-4750 Machined	69.99	44
			418-4652 Ground	54.99	44	418-4852 Ground	96.99	45

The **Slotted Angle Plate** can be attached to the **Model 410** with 1/4"-20 screws and washers, and oriented up, down or sideways, with **Objects** not glued directly to it, or the **Objects** glued to a **Magnetic Base** so that they can be easily removed and positioned during a **holographic multi-channel exposure**.

The latest incarnation of the beast, **Model 410-RC** uses a Siamese twinned set of clamps.



*. According to the scale in the **Nurse's Office**, the fully-decked out **Model 410** plus **Right Angle Platform** is 27 lbs.

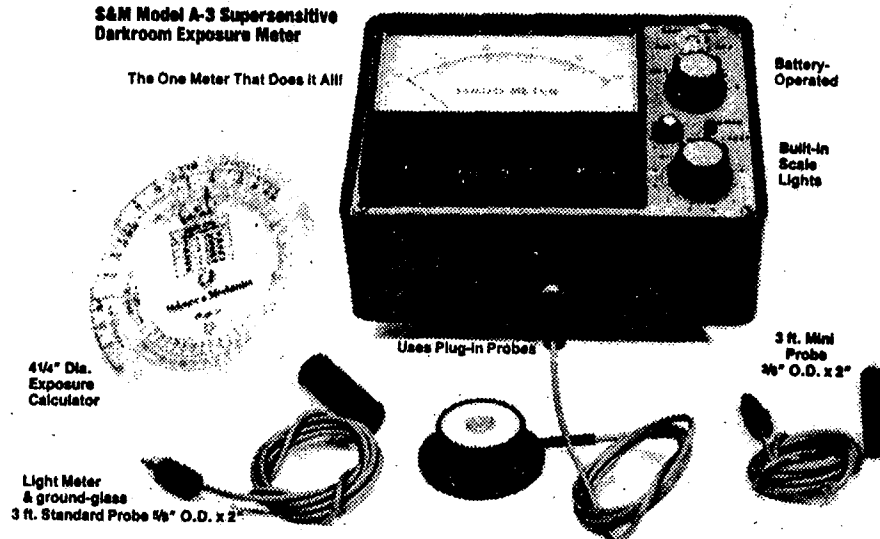
Mrs Doris Vila:

10/14/86

Prices For 1986 Models of Science & Mechanics Supersensitive Photo Meters with Accessories.

S&M Model A-3 Supersensitive
Darkroom Exposure Meter

The One Meter That Does It All!



The New Improved S&M Model 102
Super-Sensitive Photo Meter!



1. S&M Model 102 Supersensitive Photo Meter with Standard probe, exposure calculator, carrying case and manual \$119.95 Add \$4. for mailing.
2. S&M Model A-3 Supersensitive Darkroom Exposure Meter with one probe, and manual: \$159.95. Extra probes at \$19.95 each. Add \$5 for mailing.
3. Microscope Adapter for standard probe \$12.50.
4. Extra 2 7/8" dia. exposure calculator \$5.50
5. Extra 4 1/4" dia. exposure calculator \$7.50
6. All probes are interchangeable.

Send check, money order or Purchase Order to:

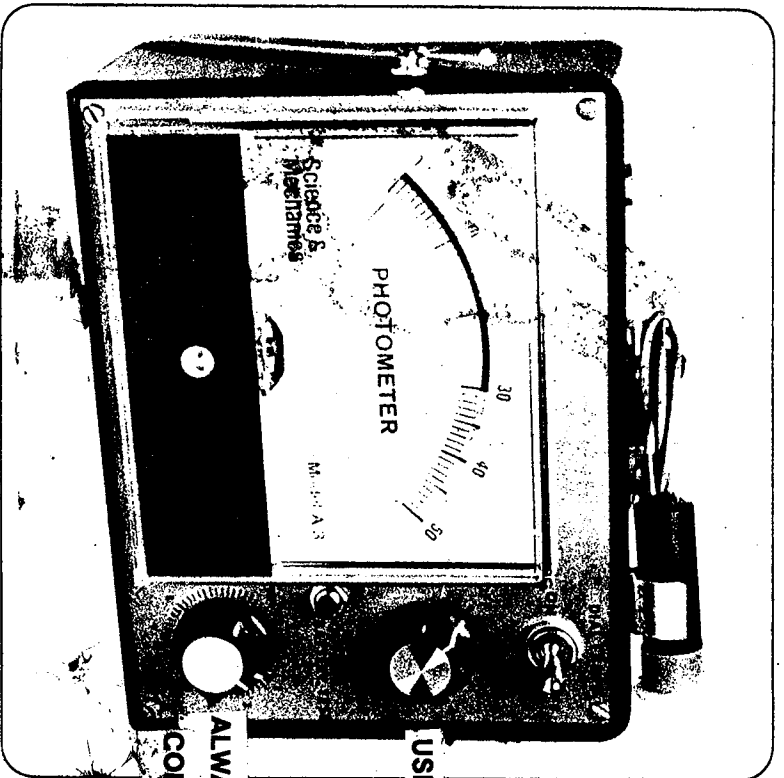
Science & Mechanics Instruments
Attn: Wilfred M. Brown
605 East 59th Street
Brooklyn, NY 11234

Tel. #718-531-3381

This versatile unit has to be the most cost efficient unit on the market. Legend says that Mr. Brown builds these in his basement in Brooklyn, and I believe it, as I have never seen any two of these things exactly the same. (viz. the difference between the 'Schroeder' and the 'ones in the pictures'). A portion of the instruction manual is reprinted, but the majority of the booklet is not, as it details how to use the unit photographically, which basically involves making a good exposure on photo film or paper, recording the intensities measured with the Model A-3, and using that as a standard. That is why there are no calibrated units on the dial, like microWatts or Lumens. We have devised our own chart which is fairly reliable.

Many Thanks for this purchase.
Best wishes,

Wilfred M. Brown



USE APPROPRIATE RANGE

ALWAYS KEEP SENSITIVITY CONTROL TURNED OFF

MANUAL FOR SCIENCE & MECHANICS' SUPERSENSITIVE PHOTO METER-DARKROOM MODEL A-3

BY WILFRED M. BROWN

INTRODUCTION Your Science & Mechanics Model A-3 Super-sensitive Photo Meter was named the "Darkroom Meter" because it is widely used for reading easel exposures for enlarging. But it is just as useful for studio photography, copy work and portraiture.

It is used with miniature, and movie cameras. The A-3 Photo Meter is also used for ground-glass exposure readings with microscopes and telescopes and can even be set up for use as a practical densitometer. One of the many new applications for this instrument in scientific photography is exposure determination for holography.

This most versatile Photo Meter gives experimenters, amateur and professional photographers and scientists, the answers to numerous light-measuring problems. The Model A-3 Photo Meter is usually supplied with a 3-foot-long Standard probe, exposure calculator and attractive carrying case.

Accessories for Your Model A-3 Photo Meter Your S & M Model A-3 Photo Meter is designed to use plug-in probes. Probes of various lengths, as may be required for certain research work, can be supplied upon request at additional cost.

An Easel probe, a Mini-probe and a Densitometer probe, each 3 feet in length, are available as accessories at \$1.99 each. A microscope adapter for use with the Standard probe is available for \$5.00.

Zeroing Your A-3 Photo Meter On receipt of your meter, you should inspect it thoroughly and note if the needle points to zero. If the needle points to the left or right of zero, you can zero it quite easily. To do so, place your meter on a level table and make certain that the Range switch and Paper Speed or Sensitivity control are in "off" positions. Use a small screwdriver, very gently, to adjust the screw at the bottom edge of the meter's face, and bring the needle exactly to the zero mark.

TESTING YOUR A-3 PHOTO METER

Battery Test Information The red-and-green arc on the scale of your meter is for battery test purpose only. When the pointer of the meter falls in the green section, the Mallory RM 630, 1.4 volt mercury cells that power the unit are good. When the pointer falls in the red section, the mercury cells must be replaced. For best accuracy, always replace weak mercury cells with the same kind of Mallory mercury cells, that are used in your meter.

Making a Battery Test To make a battery test, press lightly on the push-button switch and hold for a few seconds while you observe the test reading. Your meter should register approximately 40. Make a note of this initial reading for future reference. This is the reading you should obtain from new and good RM 630 mercury cells used as the power supply in this instrument. This reading indicates that your meter should function very well.

You can make a battery test with the probe plugged in or without the probe. In either case, the same test reading should be obtained. We recommend that you make a battery test whenever you are going to use your meter.

Testing Its Functioning Your A-3 meter is easy to use once you become familiar with it. First make certain that the Range switch and the Sensitivity control are in "off" positions. Now plug in the Standard probe and remove the clear plastic cap that protects the photocell. The plastic cap should never be used when taking reflected-light readings.

Point the photocell of the probe toward a lighted 75-watt lamp and put the Range switch on Range one. With the probe about a foot away from the bare bulb, you should get approximately a half-scale reading. Move the probe closer to the lamp and the needle should swing higher up scale, indicating that the photocell is picking up more light. Move away from the lamp and the needle immediately swings down scale, indicating that the photocell is picking up less light.

Place the probe so that you can get a reading of about 5 on Range 1 and then switch to Range 2. The needle should swing up scale to about 50 or full scale. Try out a few readings on Ranges 1 and 2 and make a note of them for later reference. Carefully check out Ranges 3 and 4 to observe the increase in sensitivity. The meter is so sensitive that on Range 4 it will even read the light that penetrates your thumb! Try it and verify for yourself. In a darkened room, on Range 4 you should get a quarter to half-scale reading at about 10 feet away from a common household candle or match.

Now check your Sensitivity control. When it is clicked into the "off" position, it has no effect on the meter. Turn on the control and rotate it clockwise to a setting between 0 and 1 on its dial. Observe the meter readings with this setting on Ranges 1 and 2. Compare them against readings taken previously on the same Ranges when this control was in the "off" position. The Sensitivity control should affect the meter readings on all Ranges, enabling you to cause the needle to rest at any desired point on the scale.

On Ranges 3 and 4 you will have to continue to turn the Sensitivity control in the clockwise direction to keep the needle on scale. When the meter is used in the darkroom, the Sensitivity control should be turned on before the Range switch to prevent the needle from "banging" off scale. On turning this control "all the way" in the clockwise direction, the needle should dip to zero. Now first turn the Range switch off, and then the Sensitivity control.

Finally, put on the toggle switch and check out the two dial lamps inside the meter. Make certain that this switch is always in the "off" position when your meter is not in darkroom use. Now put aside your meter until you are ready to use it for your work. The information supplied above is to get you acquainted with your Model A-3 meter. It is not presented for you to evaluate the accuracy of the instrument at this time. Rather, it is to show that the meter functions properly when you receive it. You will be able to determine the accuracy of your meter when you put it to the test in real photographic work.

DON'T FORGET TO TURN IT OFF!

USING YOUR A-3 PHOTO METER

AS A LIGHT METER When using the A-3 meter as a Light Meter you should first make certain that the Paper Speed or Sensitivity control is in the "off" position. This control should never be used when using the instrument as a Light Meter. The Standard probe should be utilized for this application. This probe is designed to give you accurate readings when pointed at the area of interest or at a spot of average illumination in an outdoor scene.

Plug in the Standard probe with the plastic cap removed, and then set the Range switch to an appropriate Range depending on the amount of available light. Use the unit just like you would any commercial reflected-light meter.

TO USE HOLOGRAPHICALLY

Whenever measuring light in the set up, orient the probe where the film is, usually behind a piece of glass in the filmholder. Place the probe up against the glass. You may notice that pointing the probe directly at the reference beam produces a higher reading, but this is an erroneous one, because the film is not oriented directly toward the reference beam. The probe should be oriented exactly like the film to feel the effects of the power of the light just like the film. It is like the difference between a feeling a punch connecting dead on or being dealt a glancing blow.

MEASURING THE BEAM BALANCE RATIO Start with either beam, and alternate between the two until you find the ratio you are looking for. Move the probe around behind the glass, being exposed to each of the beams to find an average reading. In the case of focussed image holograms, base the ratio on the brightest spot of the image at the film plane.

BEAM BALANCE RATIO SUGGESTIONS

TYPE OF HOLOGRAM RATIO (Reference: Object)

Laser Transmission	4:1
White Light Transmission ¹	4:1
One Step Rainbow Shadowgram	4:1
Two Beam Reflection	2:1
Diffraction Grating	1:1
Single Beam Reflection	Determined by object

TO DETERMINE THE EXPOSURE, measure both beams simultaneously. Then check the chart.

ADDENDUM TO MODEL A-3 INSTRUCTIONS

EXPOSURE CHART FOR REFLECTION OR TRANSMISSION ON PLATES			
PROCESSING: DEVELOPER CWC2 FOR 2 MINUTES + COPPER S. BLEACH			
SCALE NUMBER ON SCIENCE & MECHANICS PHOTO METER →	2	3	4
D I A L	3	24 sec	240 sec
	5	12 sec	120 sec
S E T	10	6 sec	60 sec
	20	4 sec	40 sec
I N G	30	2 sec	24 sec
	50	1 1/2 sec	12 sec

EXPOSURE CHART FOR REFLECTION OR TRANSMISSION ON FILM			
PROCESSING: DEVELOPER CWC2 FOR 2 MINUTES + COPPER S. BLEACH			
SCALE NUMBER ON SCIENCE & MECHANICS PHOTO METER →	2	3	4
D I A L	3	12 sec	120 sec
	5	8 sec	80 sec
S E T	10	4 sec	40 sec
	20	2 sec	20 sec
I N G	30	1 1/2 sec	12 sec
	40	1 sec	8 sec

The Exposure Chart was compiled by students many years ago. Recent testing has shown that if there is a reading of 15 on the 3 Scale, exposure time would be 30". And other tests showed that a 30 on the 3 Scale meant 15" exposure. Which makes perfect sense, since 30 on the 3 Scale is twice as much light as 15, so the exposure time would have to be one-half the time. And 45" was the best exposure when a 10 on the 3 Scale was read.

Notice that 15 x 30 and 30 x 15 and 10 x 45 all = 450. This number is our Holographic Film Speed Number, not unlike the ASA/ISO numbers for photography.

Except that this number is simpler to use. Simply measure the incident laser flux at the Holographic Film Plane with the Meter, divide the number on the 3 Scale into 450. The quotient will be the exposure time in seconds for Agfa Holotest 8E75HD Film, developed for 2 minutes at 75F in CWC2 Developer and bleached in the Copper Sulfate Bleach.

Holographic Plates are traditionally half as sensitive as the film product. Multiply the time found using the method above by two, or use 900 as the Plate Speed Number.

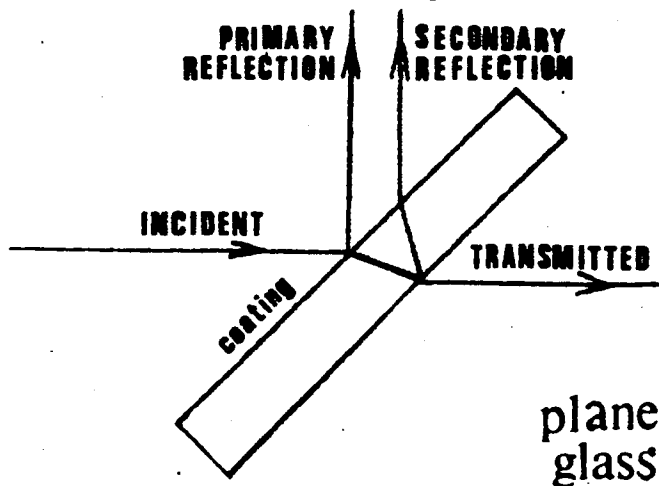
Since each scale on the Model A-3 differs from each other by a factor of 10, the Film Speed Number on the 1 Scale is 4.5, on the 2 Scale it is 45, and on the 4 Scale it is 4500.

If you examine the old chart, you will see that their Meter Reading versus Exposure Time product is essentially what we have arrived at. Kudos to all who had participated in the experiment.

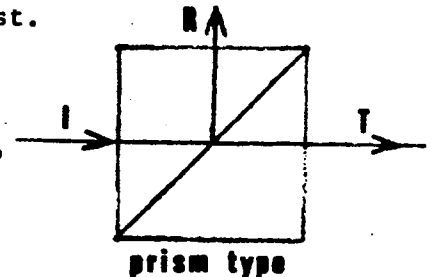
BEAMSPLITTERS

Beamsplitters divide the beam that hits them into parts, a reflected beam and a transmitted beam. They are necessary in holography for separating the laser beam into a reference beam and an object beam, and also for splitting the object beam to provide lighting of a scene from different angles.

There are two types of beamsplitters--fixed and variable. The simplest one is just a flat piece of glass where some light incident on it is reflected, with the rest passing through except for a secondary reflection of negligible intensity from the back surface. This secondary reflection may have to be blocked off, depending upon the application. With this beamsplitter about 10% of the light is reflected, with the rest (about 90%) being transmitted. But there are other fixed ratio plane glass beamsplitters that provide different ratios of reflected to transmitted light by having a semi-reflective metallic coating on one side. The more reflective the coating, the less light gets transmitted. Also, some light gets absorbed by the coating. Again, watch out for the secondary reflection, and set the splitter in a position where the beam hits the coated side first.



Another type of fixed ratio beamsplitter consists of two prisms cemented together. The reflected beam is the product of frustrated internal reflection. This beamsplitter is wasteful of the light, as 30% is reflected, 30% is transmitted, and the rest is absorbed. They do not work well with linearly polarized lasers because the direction of polarization is changed due to the internal reflections.

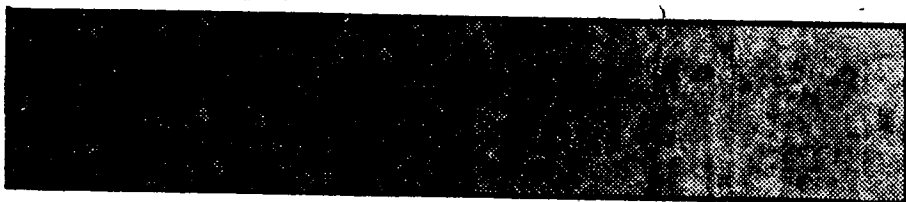


When using any of these fixed ratio beamsplitters in a holographic set up, you must control the ratio of reference to object beams by the amount of spread of the beams to control their intensities. However, this is sometimes inconvenient, if not downright frustrating. A variable beamsplitter gives a wide range of ratios by having a coating whose density varies along the length of the beamsplitter. By adjusting the beamsplitter to let the beam hit different sections of it, you can dial in whatever ratio is necessary for the set up.

variable beamsplitters

more reflective

less reflective



less transmissive

more transmissive

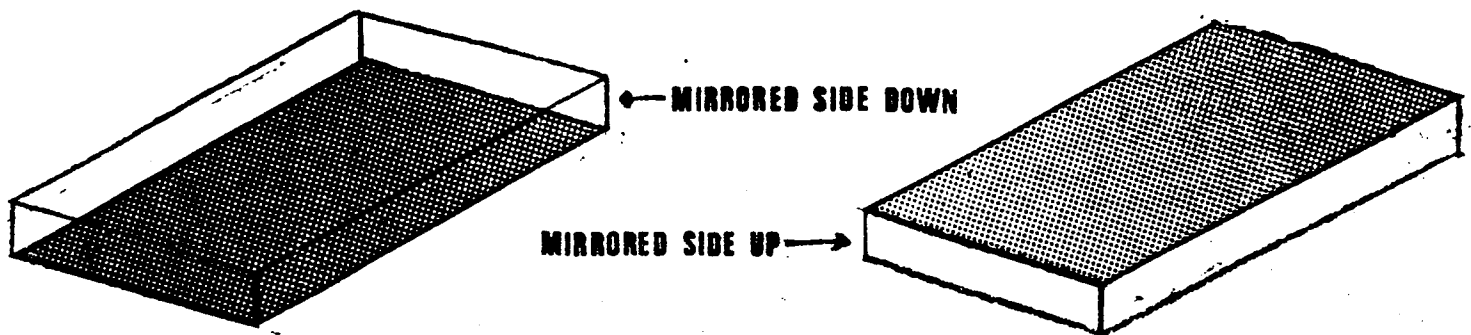
linear



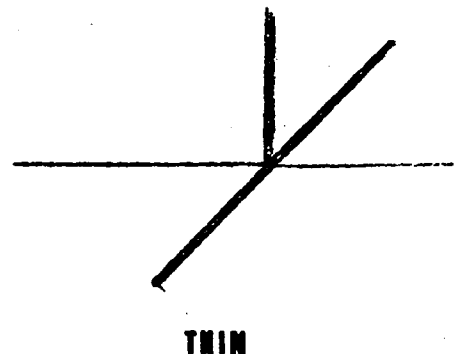
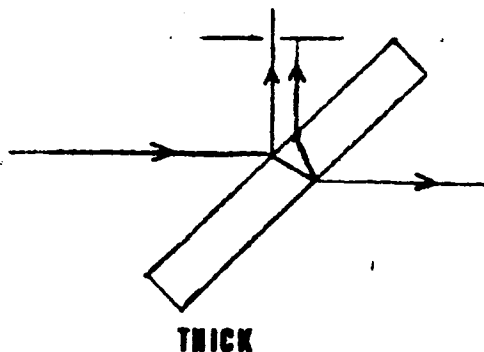
rotary

BEAMSPLITTING TIPS

Any type of beamsplitter absorbs some of the light passing through it, depending on the angle of incidence. This is unavoidable, but to minimize this loss, always place the mirrored side toward the laser. It's easy to tell which is the coated side on an unmounted beamsplitter; the thickness of the glass will be visible through the unmirrored side and the mirrored side's edge seems to end abruptly.

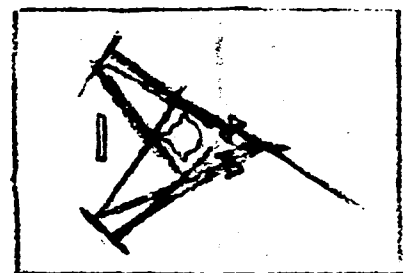
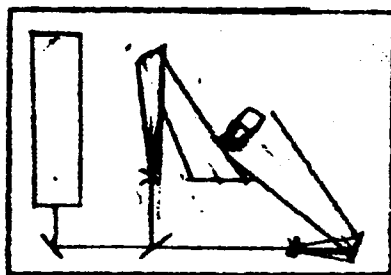
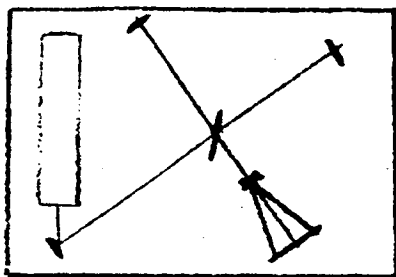


On thick beamsplitters it is easy to block off the secondary with a piece of metal with a hole drilled in it, as the distance between the two beams is determined by the thickness of the glass. But with very thin beamsplitters, the first and second reflections will be almost on top of each other and cannot be separated. This



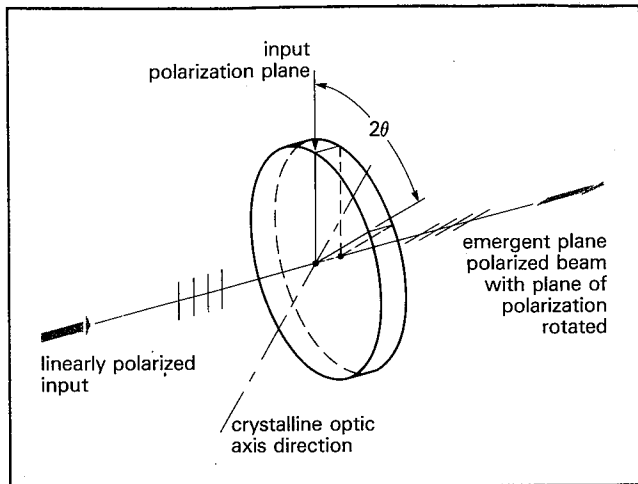
is fine for object beams, but these two reflected beams cannot be used as a reference beam because the hologram would require those same two beams for playback.

Here are some applications for beamsplitters:

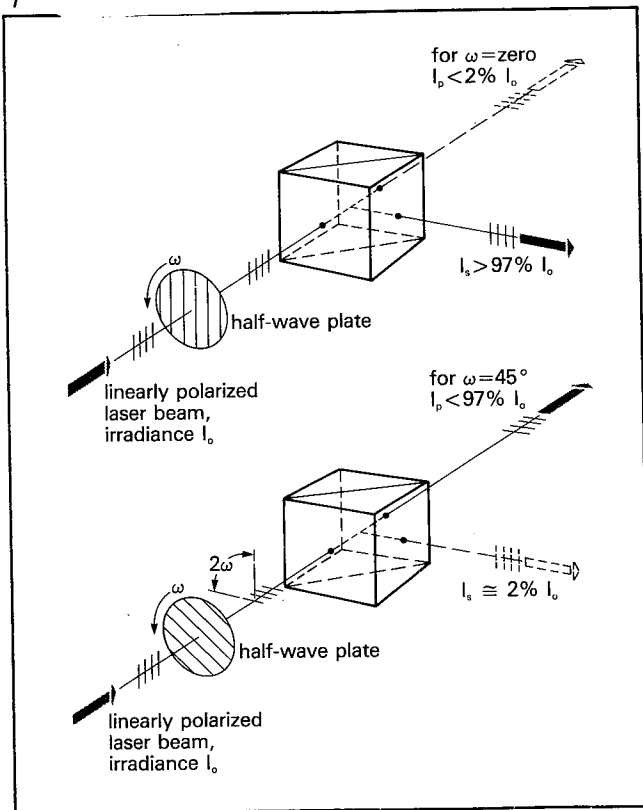


All beamsplitters should be handled with utmost care. Dust can be removed from the surfaces with a soft camel's hair brush, and uncoated plane glass ones can be cleaned with lens cleaning fluid and tissue. But all others that have the metallic coating CANNOT be cleaned for the same reason that a first surface mirror cannot be easily cleaned; the surface is too soft and is susceptible to scratches. KEEP FINGERS, SAND, ETC., OFF THE BEAMSPLITTERS!!!! DIRTY BEAMSPLITTERS AND MIRRORS END UP IN THE JUNKPILE!!!!

Although beamsplitting with a polarizing beamsplitting cube and half wave plates may seem more complicated and intimidating at first, the almost lossless nature of the optics compared with variable "reflective" coating which absorb beaucoup de photons make them invaluable for the low power He-Ne holographer. The low cost of cubes taken out of video disc machines on the surplus market makes them affordable, (\$15-25) and good enough rotating stages from the hardware store for the half wave plates complete the set up with a minimum of cash outlay.



HALF-WAVE PLATE EFFECT ON LINEARLY POLARIZED LASER BEAM. The plane of polarization of the beam can be rotated at will without rotating the laser. The plane of polarization is essentially reflected in a plane containing the crystalline optic axis, and the output plane rotates at twice the angle rate of the retarder.



VARIABLE RATIO BEAMSPLITTER: The half-wave plate rotates with angular velocity ω while the permitted plane of output polarization (here suggested by lines on the highly transparent retarder) rotates at angular velocity 2ω . The polarized beams which finally emerge from the cube have the irradiances I_h , I_v indicated. Intermediate irradiances are seen at intermediate times.

TRANSLATION

A polarized laser beam can come out of the half wave plate at any plane of polarization that you please.

By rotating the polarization plane the holographer can produce any ratio of relative intensities of the two beams.

As you would suspect, an incoming laser beam polarized in a plane 45 degrees from the normal will be split 50/50.

!!CAUTION!!

Notice that the two beams are polarized perpendicular to each other! A second and even third half wave plate might be necessary to align their vectors so that they can interfere!

The horizontally polarized beam could be used as is for a horizontally incident reference beam, while the vertically polarized one needs to be adjusted.

See the sheet, "ALIGNING POLARIZATION VECTORS"

The two output beams' polarization vectors are fixed, and independent of the incoming polarization.

From MELLES GRIOT OPTICS GUIDE.

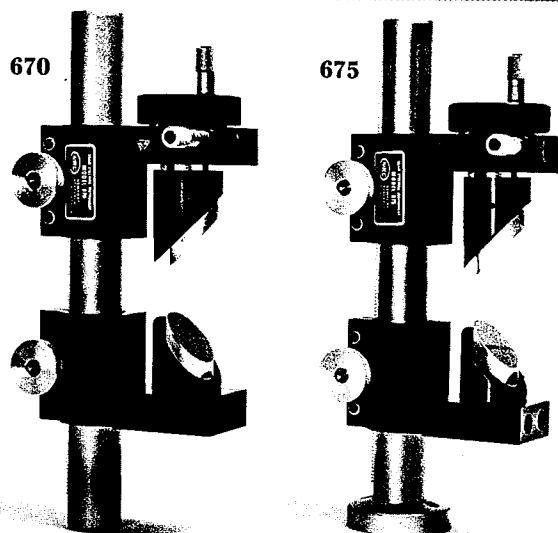
Beam Steering Instruments

- **Ultra-rigid design**
Heavy construction; all-steel rods
- **Damped rod version for unmatched stability**
Patented internal damping system provides microinch stability for critical applications
- **Coarse-fine azimuth angle control**
High-resolution angular control allows accurate beam placement over long distances
- **Broadband, $\lambda/20$ mirrors included**

Models 670 and 675 Beam Steering Instruments are premier devices for adjusting the height and direction of a laser beam. They have a kinematic exit mirror mount with independent elevation and coarse/fine azimuth adjustments, an entrance mirror adjustable in azimuth, and height adjustments for both mirrors. Their rigid construction provides excellent stability in critical applications.

In use, the lower mirror is pivoted to the desired angle using a side-mounted pin. The upper mirror holder has a hand-sized knob for coarse azimuth positioning anywhere over a 360° range, and a vernier micrometer for precision beam pointing. A second micrometer provides precise elevation adjustment. Models incorporating **AJS Adjustment Screws** (page E-4) in place of the micrometers are also offered.

Use "sawdust machine" to attach this model to the table.



Beam Steering Instruments

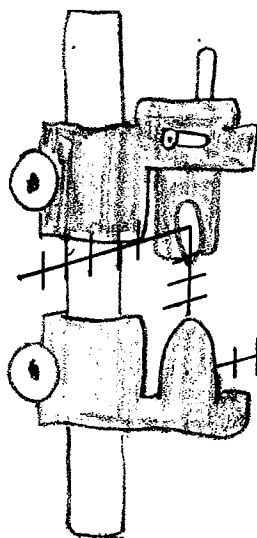
These units are used to raise or lower the beam from the laser's level to the working level.

Attach to table directly, or mount onto magnetic bases.

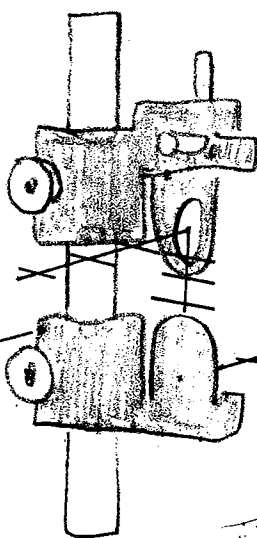
CAUTION! Using these devices in a corner can rotate the plane of polarization vector orthogonal to the input! The plane can be twisted into anything inbetween horizontal and vertical by not using right angle geometry. Of course everything can be made proper by a half-wave plate inserted into the beam.

ALONG THE STRAIGHTAWAY

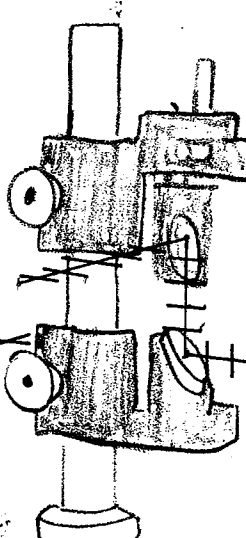
IN THE CORNER



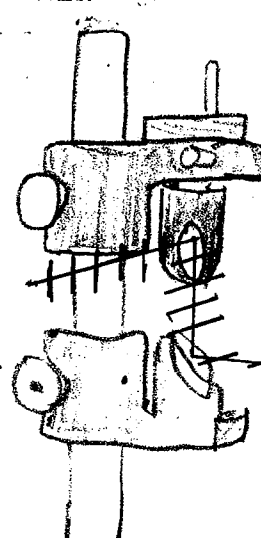
vertical
input=
vertical
output



horizontal
input=
horizontal
output



vertical
input=
horizontal
output



horizontal
input=
vertical
output

A good trick to know if you don't have half-wave plate

FROM A SOW'S EAR TO A SILK PURSE

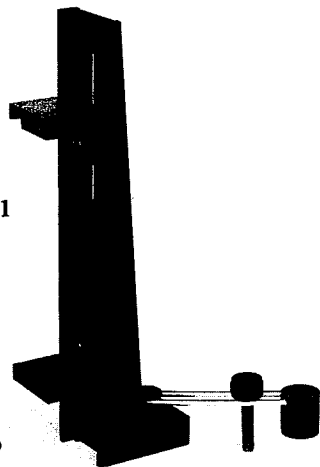
We had one of these totally worthless devices and converted it into something useful. Loaded with glass in its intended usage, the device would flop off to the side due to a basic unbalance in its design. Notice that a Model BC-2 Base Clamp is used to attach it to the table. Until that is screwed down, the thing would totter along its base, usually with catastrophic results for the glass which it held.

Its new function is to hold the **Newport Model 900 Spatial Filter** in front of the **Projector** in the **HOLOGRAPHIC STEREOGRAM PRINTER**. By using it as a cantilever arm with an adjustable slot the **Spatial Filter** can be positioned in an otherwise awkward spot. The two little "V-grooved jaws" might be found in the **MISCELLANEOUS METAL PLATE BOX** stored on the East Wall of the **PRINTER ROOM**.

Plate Glass Holder

PH-1

(Shown with
BC-2 Base Clamp)



- **Versatile, universal clamp**
Holds diffusers, baffles, screens
- **Holds objects up to 7.75 in. (197 mm) tall at any height**
- **Mounts on table easily**

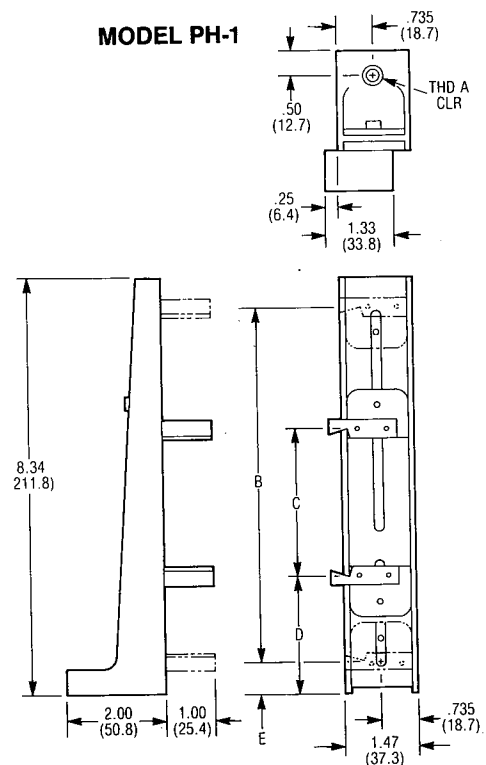
Holding thin objects at any height anywhere on a table is easy with the **PH-1 Plate Glass Holder**. Its non-marring adjustable jaws securely hold plates of arbitrary thickness at any desired height from 0.4 to 3.2 in (10 to 81 mm). For very wide plates, two holders can be used, one on each side.

The V-grooved jaws attach to reversible carriers for flush- or extended-grip configurations. PH-1 attaches to tables or breadboards with a single bolt, or it may be tied-down anywhere on a table surface with a **BC-2 Base Clamp** (below).

Plate Glass Holder

	English Model	Metric Model
Plate Glass Holder	PH-1	M-PH-1

MODEL PH-1



MODEL	THREAD A	DIMENSION							
		B		C		D		E	
		MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX
ENGLISH INCHES									
PH-1	1/4-20	1.73	7.85	.35	5.76	1.34	3.10	.30	2.07
METRIC MILLIMETERS									
M-PH-1	M6	43.9	199.4	8.9	146.3	34.0	78.7	7.62	52.6

3¹/₂ HP Air Compressor

**Maintenance Free Class
No Oil Required**

Operates these & other Air Tools intermittently:

- Commercial Spray Gun
- 1/2" Impact Wrench
- 3/8" Ratchet Wrench
- 14 pc. 3/8" & 1/2" Drive Deep Impact Socket Set
- Holographic Isolation Tables

FEATURING:

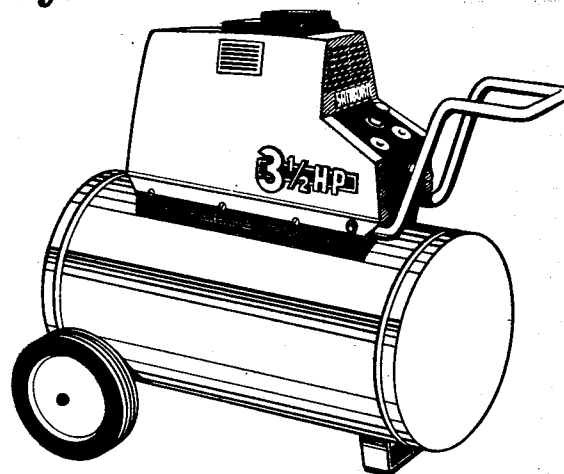
- ASME, CSA, UL certification.
- Integrated control panel consisting of built in regulator tank & working pressure gauges on/off switch for simplified operation.
- Heavy duty dual capacitor motor.
- Automatic thermal overload protection.
- Heat & impact resistant protective housing covers all working parts.
- \$5.00 Air Hose Rebate.
- Product Assistance 800-544-5145.*

**2 Year Protection Plan
Now Available***

**1 Year Limited Warranty
plus**

**1 Year Warranty Extension Option*
Purchase Option Enclosed**

ON-OFF SWITCH



MODEL BO7F350-13



Specifications

Tank Size - 13 Gallons ASME

**Air Delivery - 8.6 CFM @ 40 PSI
6.7 CFM @ 90 PSI**

Maximum Pressure - 120 PSI

Voltage/Amps - 115/15

Form 101-2314-1093

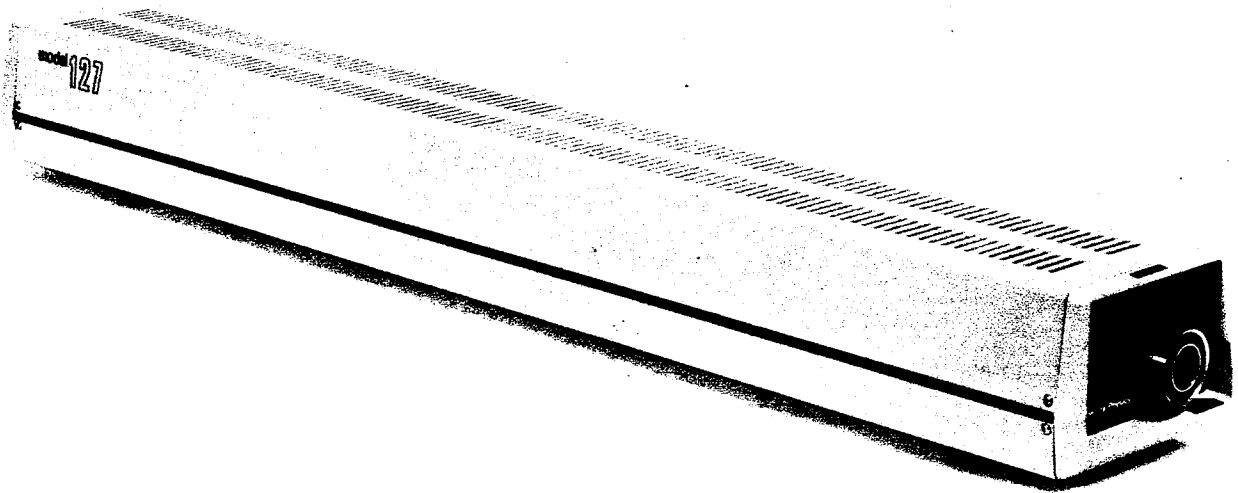
*Not available in Mexico at this time.

Manufacturing Company

BLACK MAX®

Model 127

25 or 35 mW Helium-Neon Laser



A Powerful Helium-Neon Laser for Scientific Applications

A rugged He-Ne laser that is:

- Stable
- Long Lived
- Versatile
- Easy to Use
- Dependable
- Powerful

Its 25 or 35 mW TEM₀₀ polarized output is ideal for:

- Holography
- Particle Analysis
- Laser Doppler Anemometry
- Spectroscopy
- Inspection Systems
- Entertainment Applications

Model 127 delivers either 25 or 35 mW of 632.8 nm light over a lifetime that typically exceeds 20,000 hours. This laser features high output power in a compact package designed to comply with United States safety regulations and promote ease of operation. The laser head and the power supply are integrated into a single compact unit, and an accessory bezel is provided to mount optical accessories in the beam path.

S-P* Model 127

This laser is the heart of the **SAIC HOLOGRAPHIC STEREOGRAM PRINTER**. It was purchased in 1987 and has not had to have any maintenance in all that time. (Knock on wood!)

It belongs to the Spectra-Physics 120 family of lasers, (120, 5mW; 124, 15mW; 125, 50mW; 127, 35 mW) which are third generation He-Ne technology.** At the time it was purchased it was the largest He-Ne laser Spectra-Physics currently made.***

Representing 25 years of design expertise at Spectra-Physics — the world's largest and most experienced laser manufacturer — the Model 127 is the ideal solution for many applications including spectroscopy and holography. It delivers high power you can depend on, even in difficult environments.

Stable Operation and Long Life From a Compact Package

Resonator Designed for Maximum Stability

An improved external mirror configuration, mounted on rugged adjustable plates, enhances stability over a broad temperature range. This resonator has been designed to minimize the effect of temperature changes on output power.

Hard Seals Promote Long Tube Lifetime

Hard-sealed plasma tube windows make the plasma tube impervious to contamination and provide virtually unlimited shelf life. A specially enlarged cathode and gas reservoir greatly increase operating lifetime, which typically exceeds 20,000 hours.

Integrated Packaging Makes Model 127 Easy to Use

The plasma tube and power supply are integrated into a single compact unit. There are no cables to connect, except the power cord. An emission indicator clearly signals laser operation, and a built-in shutter makes control of the output easy.

Model 127 is designed for worldwide use. A voltage selection switch on the rear panel enables either 90-130 V ac or 180-260 V ac operation.

Model 127 is designed for simple mounting on optical tables. It has five 10-32 UNC-2B mounting holes along its base. It also comes with removable rubber feet for free-standing operation. Refer to the outline drawing for locations of mounting holes and feet.

Accessory Bezel Provides Additional Versatility

Model 127 is ideal if the application requires beam focusing, expansion, or other special handling. It comes equipped with a 1-32 threaded mounting bezel for optical accessories including Spectra-Physics spatial filters and telescopes. A separate catalog describes these accessories.

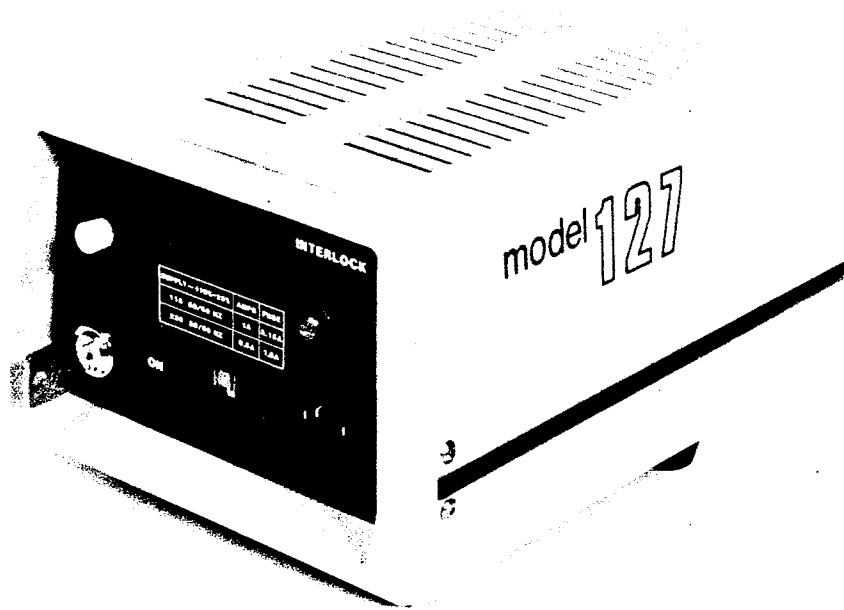


Figure 1: Model 127 is a single package whose controls are always within easy reach.

Figure 1: The **On-Off Switch** on SAIC's laser is flakey. Sometimes the laser will remain **ON** even if the switch says **OFF**. The **White Power On Bulb** has been removed for light-proofing.

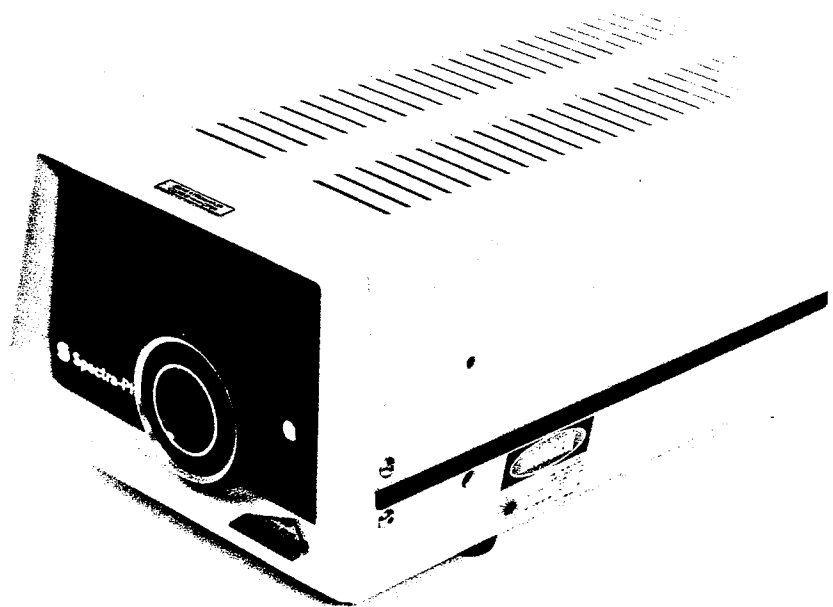


Figure 2: Check the built-in shutter on the accessory bezel if the tube lights, but no beam appears even if the **Printer's Shutter** is open. If it is open, then panic!

Specifications ¹	127-25	127-35
Optical Characteristics	25 mW	35 mW
Output Power		
Wavelength	632.8 nm	
Transverse Mode	TEM ₀₀	
Polarization Extinction Ratio	500:1	
Angle of Polarization	Horizontal $\pm 5^\circ$	
Beam Diameter @ 1/e ² Points	1.25 \pm 0.10 mm	
Beam Divergence	0.66 \pm 0.05 mrad	
Beam Waist Location	Outer surface of output mirror	
Dynamic Output Parameters		
Typical Warm-up Characteristics (% of Steady State Power)		
Power at Start-up	>75%	
Power 1 hr after Start-up	>95%	
Amplitude Noise, 10 Hz—2 MHz	<1% rms	
Amplitude Ripple, 45 Hz—1 kHz	<1% rms	
Beam Alignment Parameters		
Static Alignment (Refer to Outline Drawing)		
Beam Pointing Tolerance	± 6 mrad	
Beam Position Tolerance	± 2.3 mm	
Operating Stability ²		
Beam Pointing	<0.2 mrad	
Beam Position	<0.05 mm	
Electrical Requirements		
Voltage	90-130/180-260 V ac	
Current	1/0.5 A	
Frequency	50-60 Hz	
Environment		
Operating		
Temperature	10—50°C (50—122°F)	
Relative Humidity	10—90% noncondensing	
Nonoperating		
Temperature	-20—60°C (-4—140°F)	
Relative Humidity	5—90% noncondensing	
Shipping Weight	17.6 kg/38.8 lb	

1. Specifications subject to change without notice.
2. After 1-hr warm-up at 25 \pm 3°C

Ordering Information
Specify either Model 127-25 (25 mW) or Model 127-35 (35 mW) and identify voltage requirements.

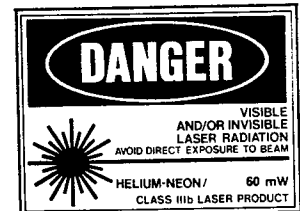
Warranty

The Model 127 is protected by a one-year warranty. All mechanical, electronic, and optical parts and assemblies, including plasma tubes, are unconditionally warranted to be free of defects in workmanship and materials during a 12 month period that begins at the time of shipment. This warranty is in lieu of all other warranties expressed or implied, and does not cover incidental or consequential loss.

Laser Safety

Spectra-Physics has worked closely with government agencies to promote the safe use of lasers and has designed this product to comply with United States standards established by the Center for Devices and Radiological Health (CDRH).

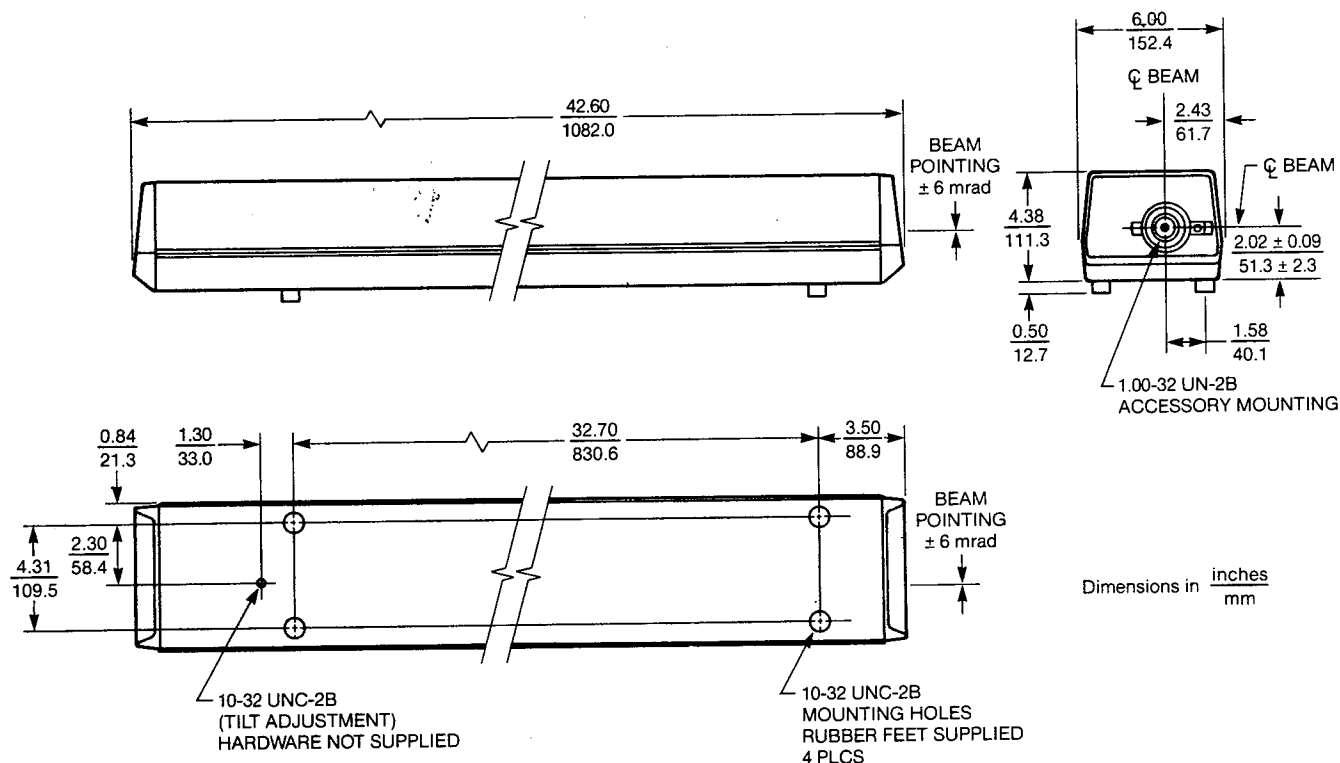
The Model 127 incorporates features for user safety and convenience as specified for Class IIIb lasers by the CDRH. A CDRH warning logotype similar to that shown appears on each laser to indicate its CDRH classification and to certify that the output power of the laser will not exceed the power level printed on the logotype.



This is the only packaged He-Ne laser that is horizontally polarized. It really doesn't make any difference, since the optics on the **HOLOGRAPHIC STEREOGRAM PRINTER** right everything to vertical for the recording of holograms.

This laser has a large beam to begin with, and coupled with its high divergence, the undiverged beam when observed at the **Printer's Plateholder** is about the size of a dime.

The laser tube is terminated with Brewster Windows, which polarize the laser beams. The resonating cavity's mirrors are attached to aluminum plates which are adjustable to peak the output. Access to them is by removing the top of the laser housing. This laser is so stable that it has not been necessary to do this for the past few years.



The laser is permanently attached to ThorLabs Stainless Steel Posts. Don't mess with the laser!

There is a lot of "collateral radiation" coming out of the vent holes on the top of the Laser. An insulated shroud covers the laser to prevent fogging of the holographic film during handling.

FOOTNOTES

*. Spectra-Physics Lasers, 1330 Terra Bella Avenue, P.O. Box 7013, Mountain View, CA 94039-7013, 800-227-8054.

** . First generation He-Ne's were Radio Frequency Excited, and didn't last very long. Second generation had filaments as the cathode, which evaporated junk on the Brewster windows; third generation lasers such as these have a big aluminum "cold cathode" in a side arm, which has long life but are harder to make than the current fourth generation tubes, which have the cathode coaxially mounted around the capillary tube wherein the lasing takes place. See the Handout, M-G LHP 171.

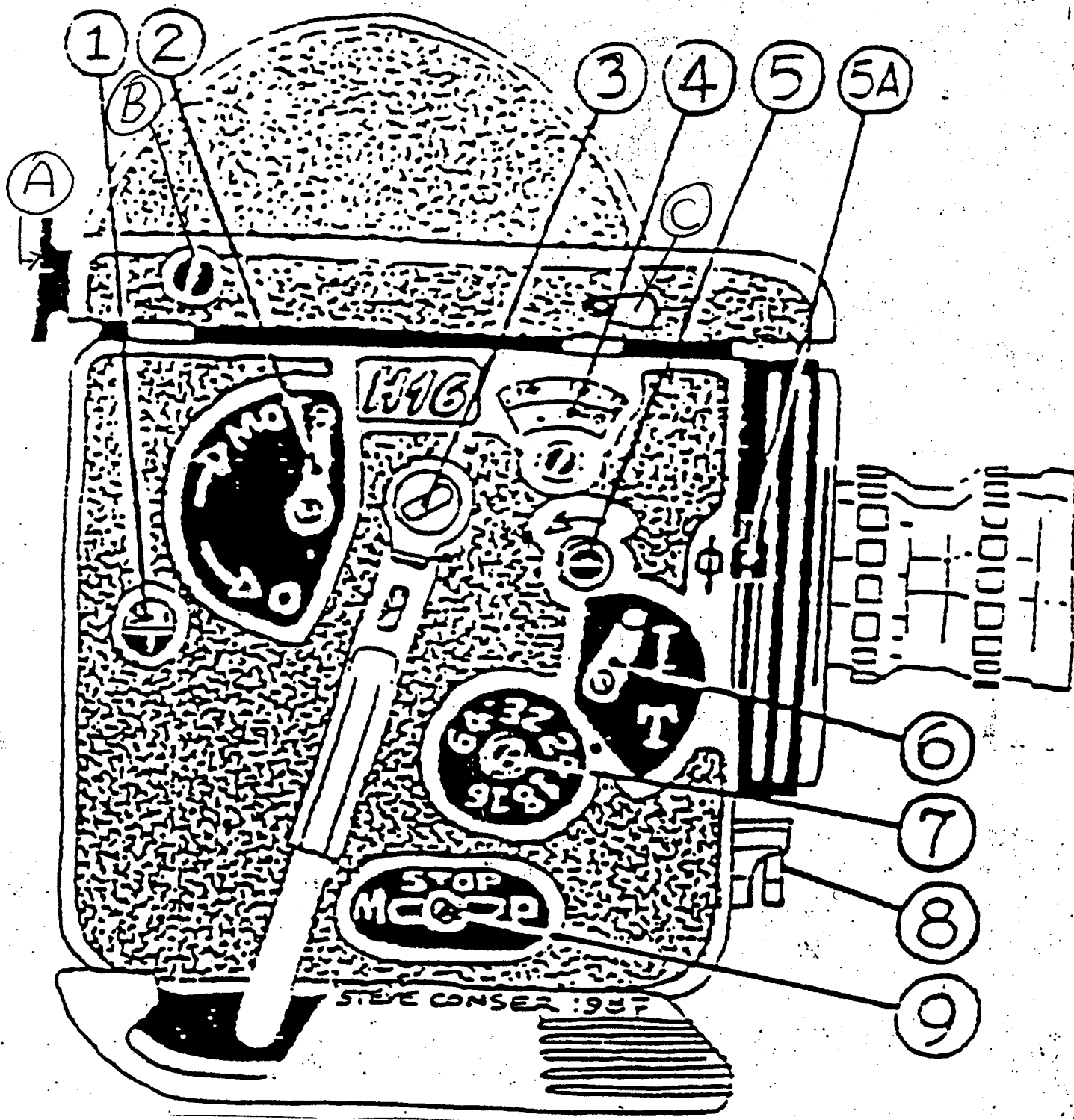
***. The only bigger He-Ne's available in the world nowadays come from NEC Electronics of Japan, in 50 and 70 mW models.

BOLEX H-16 MOVIE CAMERA

EXTERIOR VIEW

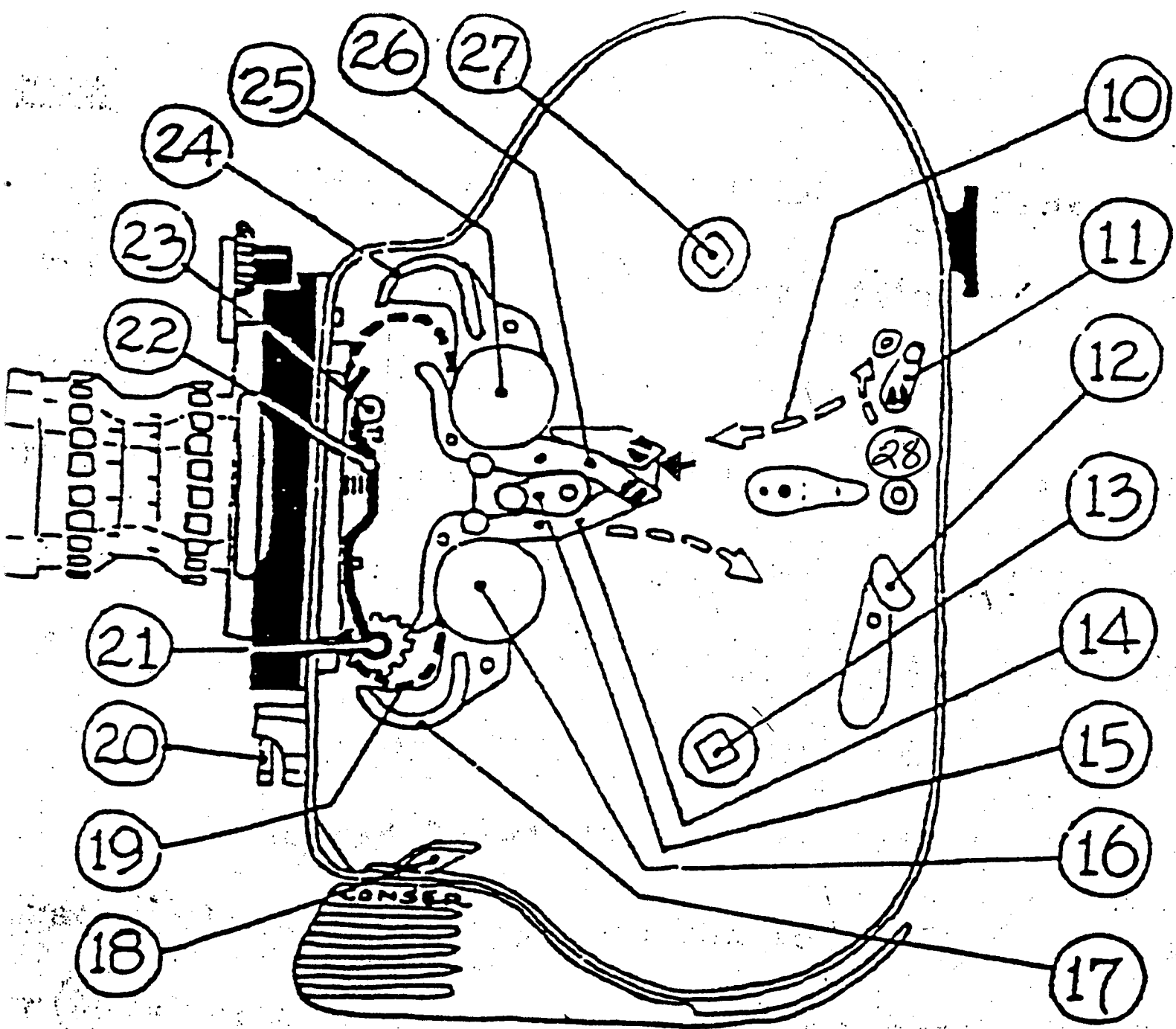
PLEASE READ THESE INSTRUCTIONS CAREFULLY BEFORE ATTEMPTING TO OPERATE THE CAMERA. IF YOU DO NOT UNDERSTAND SOMETHING - ASK. DO NOT FORCE CAMERA PARTS AT ANY TIME AS IT OFTEN LEADS TO COSTLY AND TIME-CONSUMING REPAIRS!

1. **Film Footage Counter.** Automatically set on closing camera. You **MUST** run camera from "A" to Zero to be sure of unfogged film for first shot. (ours is broken.)
 2. **Motor Disengagement Lever.** (Shown in motor engaged position.)
 3. **Motor Wind-up Handle.** Winds COUNTER-CLOCKWISE! A good wind lasts about 30-40 seconds, keep an eye on it and wind regularly, especially right before an important take.
 4. **Frame Counter,** in feet and frames. Can be reset. Used for calculating fades, dissolves, etc.
 5. **Hand Crank Spindle,** for backwinding film. (**Motor Disengagement Lever 2** **MUST** be pressed when backwinding. **DON'T EVER USE FORCE!**)
 - 5a. **Variable Shutter Lever** should remain in up position for normal filming.
 6. **Single Frame Exposure Lever.** Set to "T", **Shutter** remains open while **Side Release 9** is held on "P".
 7. **Camera Running Speed Knob.** 24 frames per second (fps) is normal for sound film footage. 16 fps is for silent film running. The **Turntable and Holographic Stereographic Printer @ SAIC** prefers the slowest possible rate on this camera, 12 fps.
 8. **Trigger to run Camera Motor.**
 9. **Side Release.** Slide to "P" for single frame, to capture images off of a video monitor or slide to "M" to hold in a steady **RUN** position while filming **Subjects** on the **Turntable**.
- not shown **Cable Release** screws over the **Side Release**. You must decide which mode you will run in "P" or "M" and attach the **Cable Release** to push 9 in the proper direction.
- A. **Eyepiece.** B. **Eyepiece Adjustment Knob.**
 - C. **Eyepiece Shutter** to prevent light from getting to the film through the **Eyepiece**.



INTERIOR VIEW

10. **Direction of Film Path.**
11. **Audible "Clicker" Lever.** In ON Position as shown, camera clicks every second at 18 fps.
12. **Film Retaining Arm.**
13. **Spindle for Take-up Reel.**
14. **Film Guides.** Can be swung aside to release film by pulling up their **Locking Pins**. Camera Door won't close unless these are back in place.
15. **Lever to move Loop Formers 17 & 24 into loading position.** Lever **MUST** be in position shown on completing loading, or camera door won't close.
16. **Film Drive Sprocket.**
17. **Loop Former for loading.** Twin to 24. (Also see 15 and **Special Loading Instructions**.)
18. **Film Trimmer.** Use to cut film before putting it into the Auto-Loader.
19. **Dotted Line shows correct film path when loaded.**
20. **Trigger Button to run Camera Motor.**
21. **Pressure Plate Removal Knob.** Ideally, TAKE OUT PRESSURE PLATE AND CLEAN IT AFTER EACH ROLL OF FILM to remove foreign objects and emulsion buildup. REPLACE IMMEDIATELY AFTER CLEANING!
22. **Pressure Plate.** (See 21 above.) Also known as the "Film Gate".
23. **Pulling the Knob swings Gate open when removing film.**
24. **Loop Former for loading.** Twin to 17. (Also see 15 and **Special Loading Instructions**.)
25. **Film Drive Sprocket.**
26. **The other Film Guide.**
27. **Spindle for Feed Reel.**
28. **Film Reels Flipper-Outer Lever to easily remove Film Reels.**
29. **Not Shown.** Ring to open camera is on **Removable Side Door**, not illustrated.



LOADING THE CAMERA

Wind up motor with Crank 3 and lay it on a clean surface. Remove Camera Door. Under lowered lighting, remove the roll of Film from its container. Trim the end of the film with the Trimmer, #18 inside the Camera Body. Close Loop Formers with Lever #15. Place Film on Feed Spindle, #27 and lead the film onto Sprocket 25, while pressing Motor Run Button 8. Film will pass through the sprockets and gate, and emerge from Sprocket 16 ready to be threaded on to a Take-up Reel which goes on Spindle 13. ALWAYS PLEASE BE SURE TO LEAVE A TAKE-UP REEL IN THE CAMERA FOR THE NEXT USER!

Return Loop Formers by using Lever 15 to snap them to their "clear" position, as in the previous illustration. IMPORTANT: Once film is completely threaded up, run camera with the door open and check that loops stay as illustrated with the Dotted Line, #19 and that film is winding correctly onto Take-up Reel. Close Camera Door and lock. If it resists, it is because #14, #15, or #26 aren't in their proper positions. Run Camera to Zero Footage and you're ready to shoot!

MISLOADS OR FILM SNARL-UP: Always listen to the Camera. If it is being noisy something is wrong; maybe the loops are deformed, or the film is zigzagging around inside the camera instead of winding up on the Take-up Reel. Open the camera up in a dark place, (like under a Changing Bag if we had one, or under a coat) and have an exploratory feel. If something is screwed up, rip the film (actually quite easy to do!) before the Sprocket Mechanism, and forward the garbage through. Then you can cut off the damaged stuff on the Feed Roll and form a new end with the Trimmer and start all over again. It is a good idea to try loading the film in normal room lighting with some dud film as a rehearsal for the real thing.

ADJUSTING THE VIEWFINDER FOCUS TO YOUR EYE: Rotate the Lens Turret so that no lens is in filming position, or screw a Lens off. Loosen the Black Ring right behind the Eyepiece, and look through the Eyepiece with the camera pointed toward a bright light source. The Shutter is closed, so there is no danger of fogging the film, even with the Lens off. Move the Ring With The Screw On It back and forth until the viewfinder's Groundglass is in sharp focus. Lock Black Ring into place and the Camera is adjusted for your eyesight, and may not necessarily work the same for anyone else. Rotate the Lens Turret so that your selected objective is at the ready.

LENS POSITIONS AND SETTINGS: Be sure **Lens Turret** is clicked home when checking the Lens's focus through the eyepiece. Remember to close down to proper **f/stop** when filming. The **Filter Holder** **MUST** be in place otherwise light leaks onto the film.

Usually the **16 to 70mm Angenieux f/2.5 Zoom Lens** is on the camera. Shoot **Stereogram Portraits** with the lens at 25mm focal length setting. But focus with the lens at the longest zoom setting, as its shallow depth of field pops the image in and out of focus quite dramatically. Then zoom back to the taking focal length.

Notice that this lens has a shutter release button built into it, as it is so massive and needs extra support. The lens is attached to the camera with a retaining ring that is screwed counter-clockwise (looking at the front of the camera) to remove the lens. It is sometimes quite difficult to take off, but please don't use any tools.

The aperture control is off to the side of the lens, over the shutter release button. The light meter built into the lens is functional, however, at this writing the the old-style Mercury battery is unavailable, and there is no contemporary replacement yet.

FILM SPEED SETTINGS: Because **Movie Cameras** expose and then transport film many times a second, the shutter timing is set by the movie framing rate. At 24 fps the longest the shutter could possibly be open would be 1/24th of a second. The actual time is much shorter since time is used up in each cycle by the **Film Claw** bringing the next frame into position. At 24 fps, the normal exposure duration is 1/60, with the transport time taking 1/40th of a second.

However, a **Prism Beamsplitter** inside the **Bolex** diverts 1/3rd of the light from the exit pupil of the lens up into the **Viewfinder**. Although soaking up light, it is a mechanically simpler and therefore more reliable design than having a reflex mirror whip in and out of position like in a 35mm SLR. Plus the image is always visible, whether the shutter is open or not. If there is no eye at the **Eyepiece**, light can leak from the **Eyepiece** into the **Film Gate**. When doing long exposures for tabletop animations or exposing from Cathode Ray Tubes, close the **Eyepiece** with **Lever C**.

Table 1 plots the shutter speeds at the various filming rates, taking into consideration the loss due to the **Reflex Viewfinder**. This is important when computing exposures using the **Light Meter**. Whenever the framing rate is changed, the f/stop must be changed too.

TABLE 1: BOLEX EXPOSURE TIME vs. FILMING SPEED

Filming Speed in fps	6	12	18	24	32	48	64
Exposure Time in seconds	1/20	1/40	1/60	1/80	1/110	1/160	1/220

Note: 1/40 is the mark inbetween 1/30 and 1/60 on the Holography Department's Sekonic L-398M Studio Deluxe II Light Meter, or where the 24 on the Cine Scale points to. See the Handout, OPERATING INSTRUCTIONS FOR THE SEKONIC STUDIO DELUXE II, MODEL L-398M.

EXPOSURE TIMES WHEN SHOOTING SINGLE FRAMES: When the Side Release, #9, is slid forward to the "P" for single frame shots, the Exposure Time is determined by the setting of the Single Frame Exposure Lever, #6. If Lever 6 is up in the "I" for Instantaneous position, then the exposure time is 1/40th of a second. If Lever 6 is down at "T" for Time, then the Shutter is open as long as the Side Release is held open by hand or Cable Release. Typically exposures of "one-thousand-one" on up to "one-thousand-two or four" are necessary for filming off of a Monitors.

SEKONIC STUDIO DELUXE II L-398M

The **Sekonic Studio Deluxe II L-398M** has been one of the Standards of the Industry for taking measurements for photographic exposures as it is rugged and easy to use in the moderate to high light levels encountered in sunlight and brightly lit movie and photographic sets.

Its light-sensitive detector, a **Selenium Cell**, is mired in 1950's technology. It acts as a solar energy cell and generates current. Therefore the unit doesn't need a battery which could be dead when you want to use the meter; however it poops out at the typical ambient room illumination level.

With the **Lumisphere** in front of the **Selenium Cell**, the **Studio Deluxe** measures the light incident* on the subject, and the meter gives the proper exposure no matter what the lightness of the subject may be. When measuring light reflected from the subject, a reflected light meter will underexpose light subjects and overexpose dark ones. Incident style light readings give more accurate exposures, as the subject's reflectivity doesn't influence the reading.

The price to pay for accuracy is inconvenience, as the incident metering step requires that the photographer stop the shooting to stick the meter in front of the subject. Meters built-into cameras are quicker, but since they are reflected light readings they are subject to the errors of the reflective sampling. Since the **SAIC Holography Department Bolex** doesn't have a built-in light meter, the **Studio Deluxe** was chosen since most of the work done with the **Bolex** is the shooting of footage for **Stereogram Portraits**, a studio exercise. Of course, this light meter works outside for landscapes**, see the last page of the **Sekonic** instructions.

The **Meter** should be stored in the **Bolex Case** with the **Camera**, in the special shelf in the **Back Lab**.

A copy of the complete instructions is stored in a three-ring binder in the **Holography Department's Bookshelf** with other instruction manuals. What follows is an abridged unauthorized version of the original.

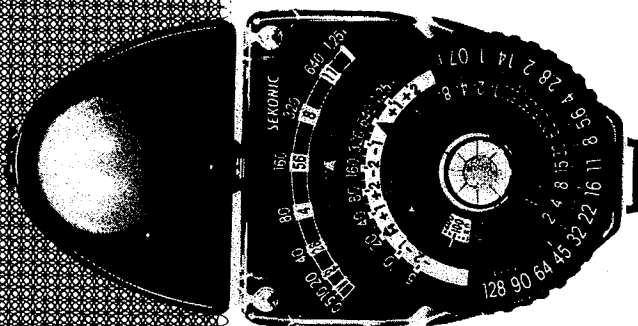
*. falling onto

. At the moment, a research program is being devised to calibrate the **Studio Deluxe for exposure suggestion off of video and computer monitors.

SEKONIC STUDIO DELUXE II

OVER 100 PHOTOGRAPHS

Model **L-398M**



SEKONIC STUDIO DELUXE II L-398M FEATURES

Nearly all photographic subjects combine complex variations of strongly reflecting surfaces (high reflectivity) and weakly reflecting surfaces (low reflectivity). These variations delicately influence exposure determination and to which portion the exposure is set becomes a vital factor that considerably affects the appearance of the finished photograph.

Although risk of failure can be minimized by taking maximum and minimum readings of all portions of the subject, then averaging the values, such an approach is both time consuming and tedious. The Studio Deluxe II is the answer to this problem. It is designed around a standard reflectivity of 18%, which has been derived through measurements of various subjects throughout the seasons of the year.

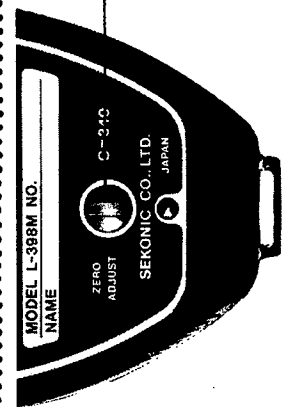
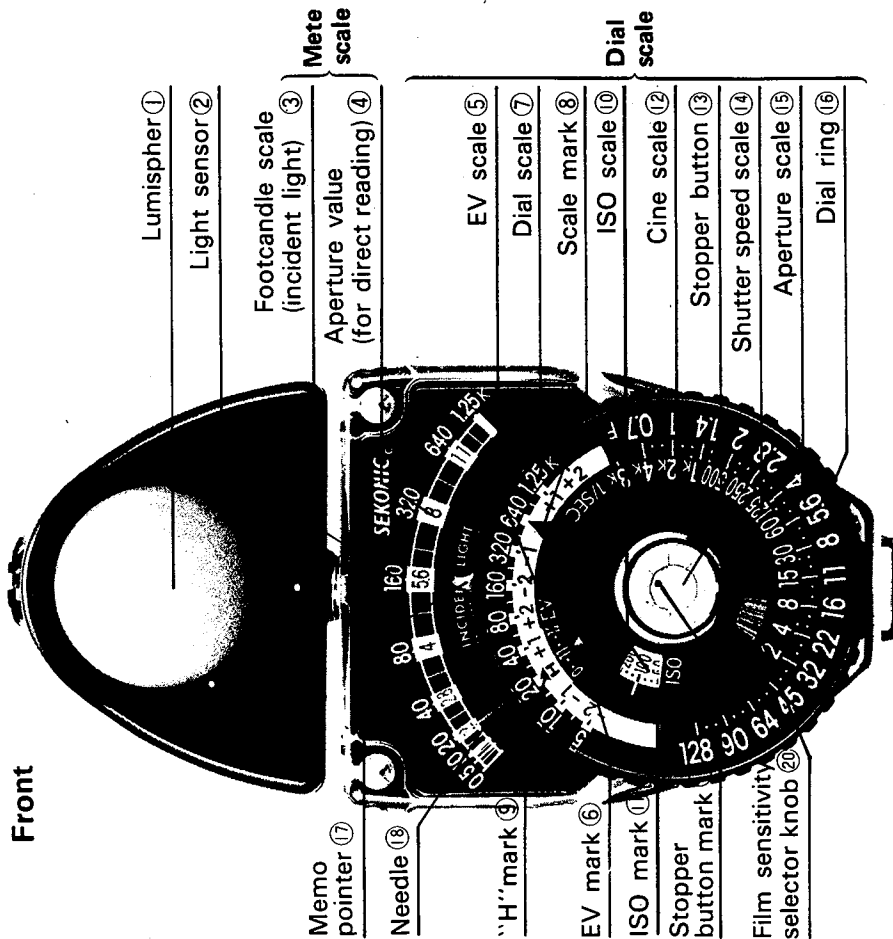
Consequently, high effectiveness is displayed with subjects possessing reflectivities in the neighborhood of 18% (people, buildings, etc.) and when this can be considered the average value (street snapshots, trees, forest scenes, etc.).

1. Optimum exposure meter for incident light measuring method (also applicable for reflected light method).
2. Freely rotatable light sensor section for very easily performed measurements.
3. Meter stopper mechanism allows operation while hand is released from meter.
4. Meter release mechanism is also included which allows the needle to deflect freely. This provides greater convenience when determining light balance.
5. Memo pointer enables easier light balance setting.
6. Luminance detects the same light as strikes the subject. Since subjects are normally 3-dimensional, according to the lighting conditions, brighter surfaces (highlights) and darker surfaces (shadows) are produced (illumination contrast). The Studio Deluxe II mechanism automatically takes into account the strength of light from all directions, causing the meter to indicate a value applicable to photography. It is thus most convenient for determining typical exposures.

SEKONIC

PART DESIGNATIONS

Front



Rear

We have all three of these; keep Lumispher on the meter; store the Lumidisc and Lumigrad in their pouch in the Meter Carrying Case.

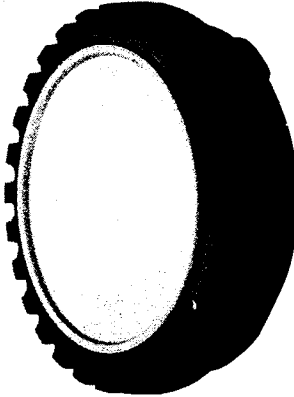
ACCESSORIES

This is stored in holder on back of meter.

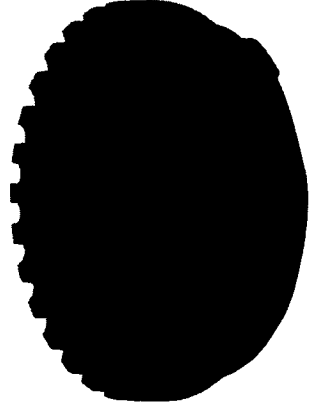
Lumispher ①



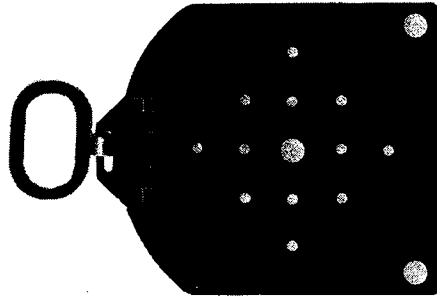
Lumidisc ②



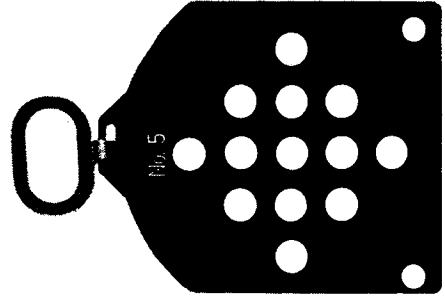
Lumigrad ③



High (H) slide ④



Optional Accessories (sold separately).
Direct reading slides.



Total of 11 direct reading slides (set of 11 slides in case).

We don't have these.

BASIC OPERATION OF METER UNIT

1. Stopper Button Operation

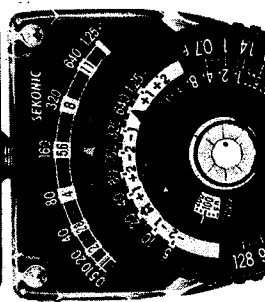
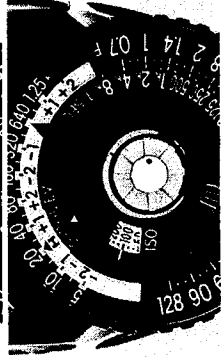
If the stopper button ⑬ is pressed when the stopper button mark ⑭ is set to ○, the meter needle ⑮ deflects according to brightness. Then when the button is released, the needle remains fixed at the indicated position.

By holding the stopper button depressed and turning it clockwise so that the mark position becomes ○, the needle is released.

At this time, the meter will deflect freely even if the stopper button is released. To fix the needle, turn the stopper button counter-clockwise to where the mark is positioned ○.

2. Zero Position Check and Adjustment

With stopper button in released position, cover light sensor with hand or black cloth to completely block light. Check that meter needle ⑮ correctly indicates zero position. If the indication deviates from zero, while observing meter indication, use a coin or similar tool to turn the rear zero adjust screw ⑰ and adjust for zero indication.



STANDARD ACCESSORY OPERATION

Incident Light Measurement

1. Lumisphere

a. Mount Lumisphere ① to light sensor ②. To mount, align white dots of Lumisphere frame and light sensor, then turn Lumisphere carefully clockwise to secure.



b. Set film sensitivity knob ⑳ to sensitivity value of employed film. Set ISO value to right side ISO mark ㉑. Photo shows setting for ISO 100.

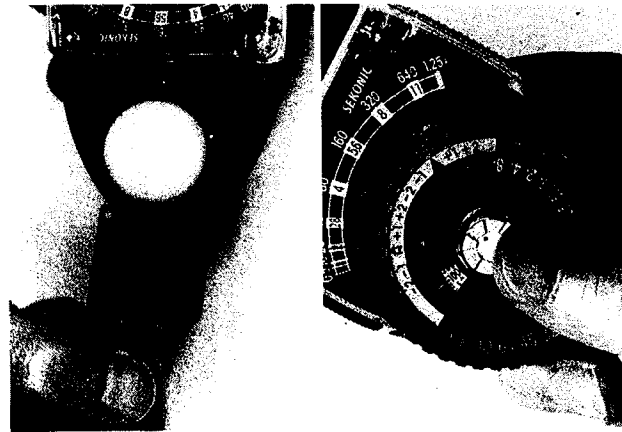
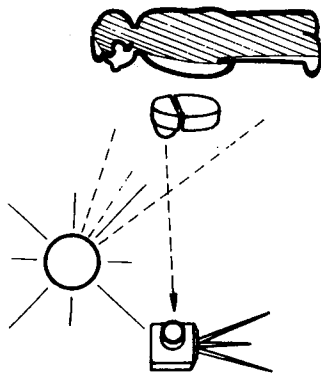


c. From position where subject is to be measured, point Lumisphere ① in direction of camera. (Light sensor ② can be turned freely.)



d. Hold meter erect and press stopper button ⑬. Meter

needle 18 deflects according to brightness. When the stopper button is released, the meter needle becomes fixed at the deflected position. If the location is excessively bright and the meter needle deflects beyond scale, insert the High slide 22.



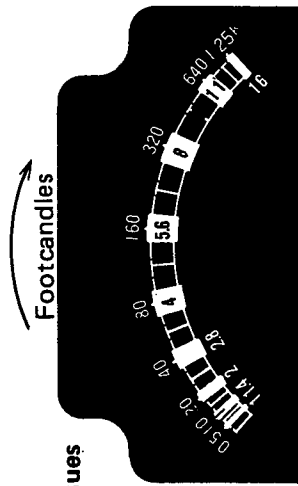
- Read the footcandle indication 3 of the meter needle.
- Transfer footcandle value to the dial scale 7. Rotate the dial ring 16 and set the scale mark. If the High slide 22 has been inserted, set the H mark.

- At this time, the shutter speed scale 14 and aperture scale 15 combination becomes the correct exposure.

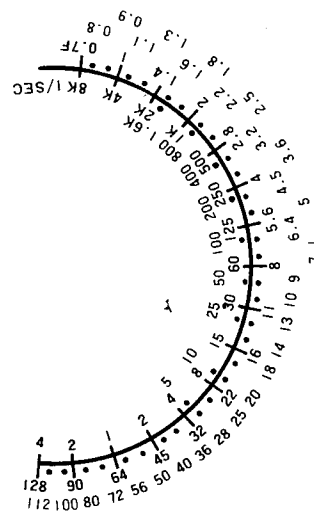
Example: With High slide inserted, meter indicates 80 footcandles.

At ISO 100, the proper exposure becomes 1/250 sec at F/5.6, 1/30 sec at F/16 and 1 sec at F/90.

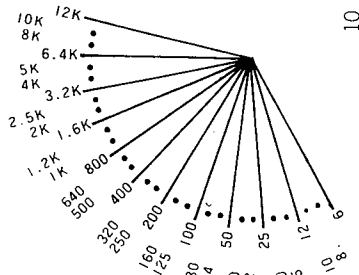
- By changing ISO setting, the set combination of shutter speed and aperture scale is automatically altered to the appropriate one corresponding to the changed ISO value.



* Meter scale intermediate values



* Intermediate values for shutter speed and aperture scale



* Film sensitivity intermediate values

Note:

When no slide is inserted, strong light directly striking the slide slot may enter through the slot.

Although this does not seriously affect exposure, if more accurate exposure is required, cover slot with hand.

ISO

Eastman Plus-X Pan Reversal 7276 is 50 under Tungsten lighting, 64 in Sunlight.

2. Lumidisc

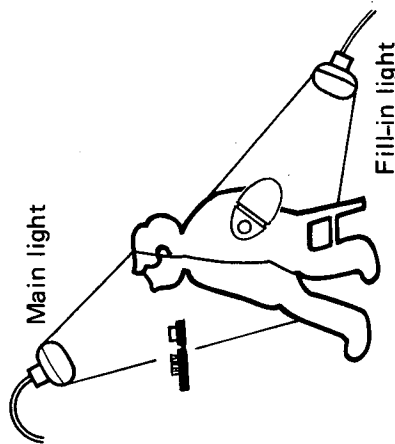
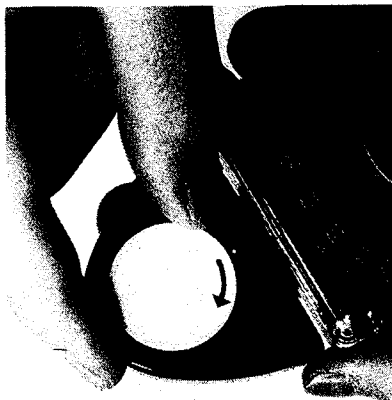
Employ for illumination contrast adjustment and luminance measurement.

- Contrast measurement
 - a. Mount Lumidisc ②③ to light sensor ②. Install in the same manner as Lumisphere.
 - b. Hold meter at subject position and point Lumidisc ②③ directly toward center of main light.
 - c. Press stopper button ⑬ and read meter scale footcandle indication ③.
 - d. Turn the memo pointer dial and set the pointer 17 at the footcandle value the needle points to.
 - e. In the same manner, measure the fill-in light. In this case, use care that light from main source does not enter sensor.
 - f. Read a difference between the footcandle value the pointer is set (see above c) and the one for fill-in light (= needle position).

Ratio between main and fill-in light footcandles becomes the contrast ratio.

Example: With main light at 640 footcandles, fill-in light reads 320 footcandles. Illumination contrast ratio becomes:

$$\frac{640}{320} = \frac{2}{1} \text{ or } 2:1$$



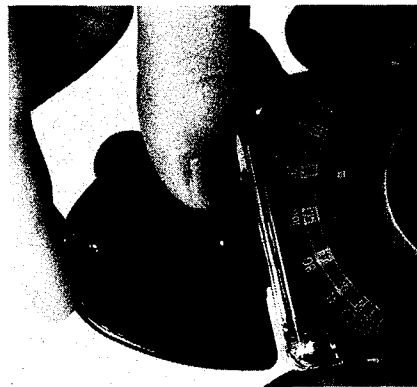
- Luminance (Lux) measurement
 - a. Mount Lumidisc ②③ to light sensor ② in the same manner as Lumisphere.
 - b. Place Lumidisc ②③ parallel with the measured surface.
 - c. Press stopper button ⑬ and read meter scale footcandle indication ③.
 - d. Multiply this value by 10.76 to obtain lux.

Example: $80 \times 10.76 = 860.8 \text{ lux}$

If meter deflects beyond scale, insert High slide ②②, then multiply footcandle indication by 32.

Example: $80 \times 32 = 2560 \text{ footcandles}$

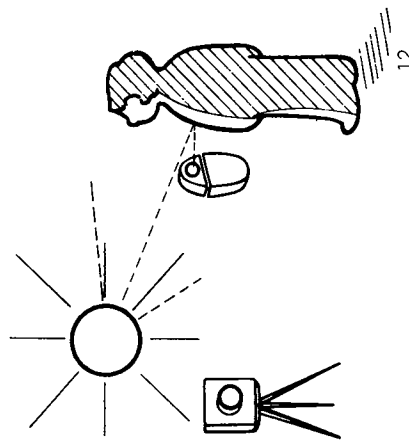
$2560 \times 10.76 = 27545.6 \text{ lux}$



Reflected Light Measurement

1. Lumigrad

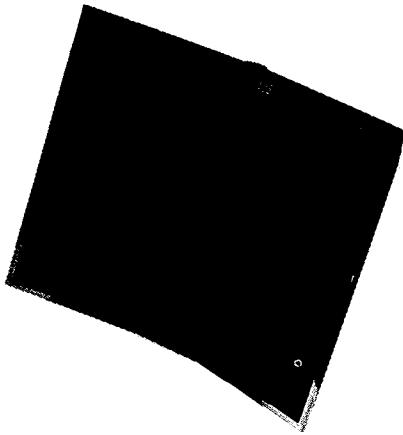
- a. Mount Lumigrad ②④ to light sensor ② in the same manner as Lumisphere.
- b. Set sensitivity value of employed film. Setting is performed in the same manner as for incident light measurement.
- c. Point Lumigrad ②④ directly toward part of subject to be measured.
- d. As close as possible to the subject, measure reflected light from main point of subject. Use adequate care at this time that meter shadow etc. does not interfere.



- e. Press stopper button ⑬ and read meter scale footcandle indication ③. However, since footcandles are units of incident light only, this value becomes simply a reference.
- f. Transfer indicated value to dial scale ⑦. Rotate the dial ring ⑮ and set ▲ mark ⑧.
- g. At this time, shutter speed scale ⑭ and aperture scale ⑮ combination becomes the correct exposure.

Note: Do not employ slides for reflected light measurement.

* More accurate results can be obtained for reflected light measurement by using a standard reflectance slide (optional accessory).



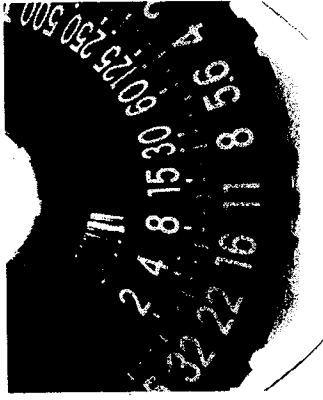
Other Operations

1. Exposure Value (EV number) Readout

Reading this exposure value to perform setting becomes convenient for cameras which employ a light value system shutter and aperture combination.

13

- a. Read meter needle ⑮ foot-candle indication ③.
- b. Transfer this number to the dial scale ⑦. Rotate dial ring ⑮ and set ▲ scale mark ⑧. If the High slide is inserted, set the ▲ mark ⑨.
- c. EV value indicated by EV mark ⑥ becomes the correct exposure value.



2. Employing Cine Scale

Incident and reflected light measurements during cine photography are performed in the same manner as described previously. However, since the cine scale ⑫ numerals correspond to cine camera film speed, read the aperture scale ⑮ indication that pertains to the employed film speed.

Note: Some cine cameras possess faster exposure times due to a narrower rotating shutter angle (angle of light transmitting portion). It is important to know the accurate film speed versus shutter angle value for your camera in order to determine proper exposure. Refer to the camera operating instructions, maker's catalogue, etc. for shutter speed information.

TABLE 1: BOLEX EXPOSURE TIME vs. FILMING SPEED

Filming Speed in fps	6	12	18	24	32	48	64
Exposure Time in seconds	1/20	1/40	1/60	1/80	1/110	1/160	1/220



MEASUREMENT EXAMPLES WITH VARIOUS SUBJECTS

1. Portrait Photography

There are various kinds of human subject photography. In a case, for example, of a skier against a snowy mountain background, the human subject simply becomes a picture detail and for the purpose of determining the exposure, this cannot be considered portrait photography. In the final analysis, portrait photography is when the human subject is in the center of the picture and the exposure adjusted to him. In addition, camera to subject distance must be considered, whether the picture is to be one person or a group.

Measurement by incident light (Lumisphere installed) displays high effectiveness in portrait photography. Perform measurement as described in the section on Incident Light Measurement. After setting the proper exposure for the human subject, lighting conditions do not present a problem and subject detail is preserved even under back lighting.



2. Typical Scenery

In the case of scenery, measure by using the Lumisphere at the camera position (refer to section on Incident Light Measurement). Although the previously described standard holding method is adequate, if lighting conditions of subject and camera positions are dissimilar, move the meter to a position where conditions are the same type as those of the subject and point in a direction parallel to the camera optical axis. If the subject is shadowed, either move the measuring position to the same type of location or reproduce the same conditions with the hand or other means. Portrayals of buildings etc. can be considered as general middle distance scenery, while main subjects can be treated in the same manner as described in the section on Portrait Photography.

HANDLING CAUTIONS

Since the Studio DeluxeII is a high precision instrument, use ample care in regard to the following points.

- Avoid dropping or subjecting it to strong shock.
- Do not store in high temperature or high humidity locations.
- Do not store in areas subject to magnetic fields or where insect repellants are located (metal cabinets, clothing dressers, etc.).
- Keep Lumisphere and Lumidisc clean and protect from scratches. If severely soiled, these can be washed in a lukewarm solution of mild detergent. Rinse and dry thoroughly.

In event service is required, contact the nearest authorized service agency. If necessary to ship the meter, be sure to surround it with at least 3cm (1-1/2") thick insulating material and pack in a sturdy, crush resistant package.

SEKONIC CO., LTD.

7-24-14, Oizumigakuen-cho, Nerima-ku, Tokyo, Japan

OPTICS CLEANING SUPPLIES

The basic rule of cleaning optics is to not have to. Keep fingers, food, smoke, dust, etc. out of the Laser Area. Clean only when necessary, like when the optical noise spectrum of bulls-eyes gets too far out of hand.

New levels of cleanliness are necessary when working with laser optics, and organic solvents, like acetone and methanol are the cleaning agents. As their name implies, they dissolve compounds that have carbon in them, and those are the items most likely to be on the mirrors and lenses, like fingerprints which are bodily secretions which are of course organic, smoke, food particles, wood chips, etc. The dirt goes into solution and is carried away by the solvent. But the rinsing or mopping action must be completed before the solvent evaporates, otherwise the contaminants will be left behind and a second wipe is necessary.

But if the solvent itself has impurities floating around in it, there will always be a residue deposited, causing noise further down in the optical path. The figure of merit for the selection of acetone is the "residue after evaporation", which should be as low as possible, like fractions of parts per millions. This stuff will be available from scientific suppliers only, so be prepared to spend about \$25 per litre or more! Don't use this stuff for cleaning your paintbrushes! The common hardware store grade will do just fine for the lower levels of cleanliness you can get by with outside of the Laser Lab.

Here are the optical cleaners that are stored in the optics cleaner niche in the middle shelf of the big storage area in the **PRINTER ROOM**.

APPLICATORS

KODAK LENS CLEANING TISSUE: The standard of the industry for cleaning optics, as they are soft, lintless, and hold cleaning liquids well and trap dirt in its fibers to be carried off.

PHOTO-WIPES: These are soft, lint-free paper towels that are useful for cleaning glass, soft enough even for cleaning plexiglass, for cleaning holographic film, for dragwiping front surface mirrors when no Kodak Lens Cleaning Tissue is available, or just to provide a clean area to lay things on.

Something almost as good but a lot cheaper are **Microwaveable Bounty Paper Towels**. The microwaveable style is unbleached paper and is the softest of all disposable towels.

Q-TIPS or equivalent cotton swabs. The ends will leave lint on optics sometimes, and plastic sticks will dissolve in acetone, so

they are not the best things to use on laser optics, but the Holography Department stocks them to clean hard to get mechanical items, like the Film Gate in the PRINTER.

SOLUTIONS

SPECTROSCOPIC GRADE ACETONE: Pour a little bit from the bottle into the cap, and use that to pour the acetone onto the surface to be cleaned. Never put anything into the bottle, as our acetone has only .000001% residue after evaporation. (One part per 100 million.)

GLASS CLEANER: For cleaning glass, but not plexiglass. Can be used for cleaning the non-emulsion side of a holographic plate, as some ammonia-based solutions can peel the emulsion clean off, like Laundry Bleach. Spray the cloth, not the glass is the basic rule for artwork.

PLEXIGLASS CLEANER: For cleaning plexiglass, as well as plain glass. Use only the softest of cloths, and wipe the finished artwork only vertically, as horizontal scratches show up worse than vertical under top-lit replay conditions.

KODAK or EDWAL FILM CLEANER: For cleaning both side of holographic films and plates, or 16mm footage for the printer. Wet a Photo-Wipe with the stuff liberally, and pass the film through it in one direction only to avoid moving the dirt from one spot to another.

KODAK LENS CLEANER FLUID: is the best thing to use on microscopes objectives, cylindrical lenses, and of course, photographic objectives like those in the Stereogram Printer. **DON'T** use it on front surface mirrors.

UNIVERSAL PHOTONICS #33 METAL BLOCKING SPRAY is a useful item for cleaning the large front-surface mirrors. Just spray it on, let it dry, and peel it off, hopefully taking all the crud with it. It's not a bad idea to apply it to mirrors that will not be used for a while as a protective measure.

LAUNDRY BLEACH: Not to be used on optics, but on unholograms; plates that didn't come out for one reason or another. Simply soak the dud in a tray of bleach, and watch the emulsion fizz off! The stripped glass can be used as a cover glass for on that turned out, painted on as a target, etc.

It can be used on the holographer who has a case of the dreaded brown pyro fingers. Just remember to use a hand creme after the Clorox soak to prevent drying of the skin.

THE FINE ART OF DRAG-WIPING

Drag-wiping is the laser age technique of cleaning optics. Reprinted below is the straight poop from the professionals, Coherent Optics Division.

Before proceeding, blow off as much loose crud as possible with compressed air. The pre-soak of Step 2 is optional except in extreme cases.

Hard Coatings

For most lasers operating from the UV to near IR, glass or fused silica optics are used and the coating materials are usually hard refractory oxides. The most common of these are: SiO_2 , TiO_2 , ZrO_2 , Al_2O_3 . All of these materials must be evaporated at very high temperatures using an electron beam gun. Once applied, they are very durable and usually harder than the substrates themselves. When cleaning hard coatings or Brewster windows we recommend the following technique:

- 1. Remove the mirror from the laser in the manner outlined in the instruction manual.
- 2. Completely remove all excessive amounts of oil, grease, dirt, heat sink compound or other contaminants. This may be done by washing in warm soapy water (use a mild liquid detergent) or acetone (spectrophotometric or electronic grade). Gently flush the part with the solution, being very careful not to abrade the surface. Wipe off excess dirt and solution with tissue (white only).
- 3. After the above preparatory cleaning (which is not always necessary) the mirror is ready for the essential final cleaning. For this step we recommend acetone as the cleansing solvent and the "drop and drag" technique. Always hold the mirror by the edge or place on a clean work surface.
- 4. Hold a piece of lens tissue above the mirror and put a few drops of acetone on the paper. (Figure 1.)
- 5. Lower the lens tissue onto the mirror and pull it across the mirror. (Figure 2.) Note that the dry part of the tissue helps remove any acetone residue.
- 6. Repeat the above step until the mirror is clean. Do not reuse the lens tissue. Doing this would drag any loose particles back across the surface and possibly scratch the coating. A clean sheet of lens tissue should be used for each wipe (drag).

Many people recommend ethyl or methyl alcohol in place of acetone in the above procedure. This is fine if the following precaution is observed: Don't let the drops of solvent extend across the lens tissue to your fingers. If this happens oil will be drawn from your fingers and deposited on the mirror surface. In addition, alcohol evaporates more slowly than acetone and may stain the surface. If the coating doesn't look clean repeat steps 3 & 4 and possibly follow with an acetone wipe.

Use Kodak Lens Cleaning Tissue for drag-wiping optics, as shown in the illustration above, or in the case of the camera lenses, follow the directions below.

How to clean a lens

Careless "cleaning" can spoil the precision of a lens. Too, you can mar the reflection-reducing coating that's given practically all fine modern lenses. KODAK Lens Cleaning Paper is your basic lens-care equipment.

Use it, loosely wadded, to brush dust from a lens.

Use it, sheet-wise, to wipe the surface of a lens gently, with a circular motion.

To remove fingerprints, moisten the paper with a drop of lens cleaner, such as KODAK Lens Cleaner.

Clean front and back surfaces of a lens only. Never disassemble a complex lens; that's a job for specialists.

Take care of your lenses. Unless they are clean, they cannot give you the crisp detail, the undistorted color you have a right to expect in your photographs:

Holograms



Figure 1



Figure 2

Tap Drill Sizes

Number of Turns	Threads per Inch	Size of Screw in Decimals	Body Drill for Intermediate	Size or Number of Drill for Per Cent of Full Thread For General Use Except as Noted in Four Columns at Right of Table								Thread Dimensions																																																																										
				100%	80%	75%	70%	60%	50%	50-60%	60-70%	70-75%	75-80%																																																																									
0	80	.0578	52	51	58	57	56	55	54	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80																																																	
1	72	.0710	48	46	55	54	54	54	54	53	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80																																																
2	64	.0842	43	42	53	52	51	50	50	49	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80																																												
3	56	.0973	38	36	49	48	47	46	45	44	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80																																							
4	48	.1105	32	31	41	40	39	38	37	36	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80																															
5	40	.1236	27	26	36	35	34	33	32	31	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80																										
6	36	.1368	22	20	31	30	29	28	27	26	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80																					
7	32	.1500	22	20	28	27	26	25	24	23	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80																		
8	32	.1631	18	17	26	25	24	23	22	21	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80																
9	32	.1763	14	12	22	21	20	19	18	17	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80												
10	24	.1894	9	6	18	17	16	15	14	13	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80								
11	24	.2025	9	6	16	15	14	13	12	11	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80						
12	24	.2158	8	6	14	13	12	11	10	9	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80				
13	20	.2287	8	6	12	11	10	9	8	7	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80		
14	20	.2421	8	6	10	9	8	7	6	5	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80

Tap drill size shown are for holes as deep as the diameter of tap. A 50% thread will break the hole, unless it will strip - in most cases. For this sheet, the 50% thread is shown for all sizes. For every 10% increase in thread, the hole size must be increased by 10% of the hole size. A 100% thread is only 5% stronger than a 75% thread, but it requires three times the power to tap.

Tap Drill Sizes

Number of Screw	Threads per Inch	Size of Screw in Decimals	Body Drill for Intermediate	Body Drill for Intermediate	Size or Number of Drill for Per Cent of Full Thread For General Use Except as Noted in Four Columns at Right of Table												
					100%	80%	75%	70%	60%	50%	50-60%	60-70%	70-75%	75-80%			
1/4	20	.2500	17/64	.2109	13	8	7	6	4	3	4	4	2	3	7	75	80%
1/8	28	.3125	19/64	.2422	13	8	7	6	4	3	4	4	2	3	7	75	80%
3/16	18	.3750	21/64	.2812	13	8	7	6	4	3	4	4	2	3	7	75	80%
1/2	14	.3125	21/64	.2812	13	8	7	6	4	3	4	4	2	3	7	75	80%
5/8	16	.3750	21/64	.2812	13	8	7	6	4	3	4	4	2	3	7	75	80%
3/4	14	.3750	21/64	.2812	13	8	7	6	4	3	4	4	2	3	7	75	80%
7/8	14	.4375	29/64	.3594	13	8	7	6	4	3	4	4	2	3	7	75	80%
1	12	.5000	31/64	.3906	13	8	7	6	4	3	4	4	2	3	7	75	80%
1 1/8	12	.5625	31/64	.3906	13	8	7	6	4	3	4	4	2	3	7	75	80%
1 1/4	11	.6250	31/64	.3906	13	8	7	6	4	3	4	4	2	3	7	75	80%
1 3/8	10	.6875	31/64	.3906	13	8	7	6	4	3	4	4	2	3	7	75	80%
1 1/2	9	.7500	31/64	.3906	13	8	7	6	4	3	4	4	2	3	7	75	80%
1 5/8	8	.8125	31/64	.3906	13	8	7	6	4	3	4	4	2	3	7	75	80%
1 3/4	7	.8750	31/64	.3906	13	8	7	6	4	3	4	4	2	3	7	75	80%
1 7/8	6	.9375	31/64	.3906	13	8	7	6	4	3	4	4	2	3	7	75	80%
2	5	1.0000	31/64	.3906	13	8	7	6	4	3	4	4	2	3	7	75	80%
2 1/8	4	1.0625	31/64	.3906	13	8	7	6	4	3	4	4	2	3	7	75	80%
2 1/4	3	1.1250	31/64	.3906	13	8	7	6	4	3	4	4	2	3	7	75	80%
2 3/8	3	1.1875	31/64	.3906	13	8	7	6	4	3	4	4	2	3	7	75	80%
2 1/2	2	1.2500	31/64	.3906	13	8	7	6	4	3	4	4	2	3	7	75	80%
2 5/8	2	1.3125	31/64	.3906	13	8	7	6	4	3	4	4	2	3	7	75	80%
2 3/4	1	1.3750	31/64	.3906	13	8	7	6	4	3	4	4	2	3	7	75	80%
2 7/8	1	1.4375	31/64	.3906	13	8	7	6	4	3	4	4	2	3	7	75	80%
3	1	1.5000	31/64	.3906	13	8	7	6	4	3	4	4	2	3	7	75	80%

Tap drill size shown are for holes as deep as the diameter of tap. A 50% thread will break the hole, unless it will strip - in most cases. For this sheet, the 50% thread is shown for all sizes. For every 10% increase in thread, the hole size must be increased by 10% of the hole size. A 100% thread is only 5% stronger than a 75% thread, but it requires three times the power to tap.

INCHES TO MILLIMETERS

in.	mm.	in.	mm.	in.	mm.	in.	mm.	in.	mm.
.01	.254	.11	2.794	.21	5.334	.31	7.874	.41	10.414
.02	.508	.12	3.048	.22	5.588	.32	8.128	.42	10.668
.03	.762	.13	3.302	.23	5.842	.33	8.382	.43	10.918
.04	1.016	.14	3.556	.24	6.096	.34	8.636	.44	11.168
.05	1.270	.15	3.810	.25	6.350	.35	8.890	.45	11.418
.06	1.524	.16	4.064	.26	6.604	.36	9.144	.46	11.668
.07	1.778	.17	4.318	.27	6.858	.37	9.398	.47	11.918
.08	2.032	.18	4.572	.28	7.112	.38	9.652	.48	12.168
.09	2.286	.19	4.826	.29	7.366	.39	9.906	.49	12.418
.10	2.540	.20	5.080	.30	7.620	.40	10.160	.50	12.668
.11	2.794	.21	5.334	.31	7.874	.41	10.414	.51	12.918
.12	3.048	.22	5.588	.32	8.128	.42	10.668	.52	13.168
.13	3.302	.23	5.842	.33	8.382	.43	10.918	.53	13.418
.14	3.556	.24	6.096	.34	8.636	.44	11.168	.54	13.668
.15	3.810	.25	6.350	.35	8.890	.45	11.418	.55	13.918
.16	4.064	.26	6.604	.36	9.144	.46	11.668	.56	14.168
.17	4.318	.27	6.858	.37	9.398	.47	11.918	.57	14.418
.18	4.572	.28	7.112	.38	9.652	.48	12.168	.58	14.668
.19	4.826	.29	7.366	.39	9.906	.49	12.418	.59	14.918
.20	5.080	.30	7.620	.40	10.160	.50	12.668	.60	15.168
.21	5.334	.31	7.874	.41	10.414	.51	12.918	.61	15.418
.22	5.588	.32	8.128	.42	10.668	.52	13.168	.62	15.668
.23	5.842	.33	8.382	.43	10.918	.53	13.418	.63	15.918
.24	6.096	.34	8.636	.44	11.168	.54	13.668	.64	16.168
.25	6.350	.35	8.890	.45	11.418	.55	13.918	.65	16.418
.26	6.604	.36	9.144	.46	11.668	.56	14.168	.66	16.668
.27	6.858	.37	9.398	.47	11.918	.57	14.418	.67	16.918
.28	7.112	.38	9.652	.48	12.168	.58	14.668	.68	17.168
.29	7.366	.39	9.906	.49	12.418	.59	14.918	.69	17.418
.30	7.620	.40	10.160	.50	12.668	.60	15.168	.70	17.668
.31	7.874	.41	10.414	.51	12.918	.61	15.418	.71	17.918
.32	8.128	.42	10.668	.52	13.168	.62	15.668	.72	18.168
.33	8.382	.43	10.918	.53	13.418	.63	15.918	.73	18.418
.34	8.636	.44	11.168	.54	13.668	.64	16.168	.74	18.668
.35	8.890	.45	11.418	.55	13.918	.65	16.418	.75	18.918
.36	9.144	.46	11.668	.56	14.168	.66	16.668	.76	19.168
.37	9.398	.47	11.918	.57	14.418	.67	16.918	.77	19.418
.38	9.652	.48	12.168	.58	14.668	.68	17.168	.78	19.668
.39	9.906	.49	12.418	.59	14.918	.69	17.418	.79	19.918
.40	10.160	.50	12.668	.60	15.168	.70	17.668	.80	20.168
.41	10.414	.51	12.918	.61	15.418	.71	17.918	.81	20.418
.42	10.668	.52	13.168	.62	15.668	.72	18.168	.82	20.668
.43	10.918	.53	13.418	.63	15.918	.73	18.418	.83	20.918
.44	11.168	.54	13.668	.64	16.168	.74	18.668	.84	21.168
.45	11.418	.55	13.918	.65	16.418	.75	18.918	.85	21.418
.46	11.668	.56	14.168	.66	16.668	.76	19.168	.86	21.668
.47	11.918	.57	14.418	.67	16.918	.77	19.418	.87	21.918
.48	12.168	.58	14.668	.68	17.168	.78	19.668	.88	22.168
.49	12.418	.59	14.918	.69	17.418	.79	19.918	.89	22.418
.50	12.668	.60	15.168	.70	17.668	.80	20.168	.90	22.668
.51	12.918	.61	15.418	.71	17.918	.81	20.418	.91	22.918
.52	13.168	.62	15.668	.72	18.168	.82	20.668	.92	23.168
.53	13.418	.63	15.918	.73	18.418	.83	20.918	.93	23.418
.54	13.668	.64	16.168	.74	18.668	.84	21.168	.94	23.668
.55	13.918	.65	16.418	.75	18.918	.85	21.418	.95	23.918
.56	14.168	.66	16.668	.76	19.168	.86	21.668	.96	24.168
.57	14.418	.67	16.918	.77	19.418	.87	21.918	.97	24.418
.58	14.668	.68	17.168	.78	19.668	.88	22.168	.98	24.668
.59	14.918	.69	17.418	.79	19.918	.89	22.418	.99	24.918
.60	15.168	.70	17.668	.80	20.168	.90	22.668	1.00	25.168

Note: This table is exact. (Basis: 1 inch = 25.4 millimeters)

MILLIMETERS TO INCHES

mm.	in.	mm.	in.	mm.	in.	mm.	in.
25 .0096	6.50 .2559	12.75 .5029	19.00 .7600	25 .0096	6.50 .2559	12.75 .5029	19.00 .7600
50 .0197	6.75 .2657	13.00 .5118	19.25 .7679	50 .0197	6.75 .2657	13.00 .5118	19.25 .7679
75 .0295	7.00 .2764	13.25 .5217	19.50 .7776	75 .0295	7.00 .2764	13.25 .5217	19.50 .7776
1.00 .0391	7.25 .2864	13.50 .5315	20.00 .7874	1.00 .0391	7.25 .2864	13.50 .5315	20.00 .7874
1.25 .0492	7.50 .2963	13.75 .5413	20.25 .7972	1.25 .0492	7.50 .2963	13.75 .5413	20.25 .7972
1.50 .0591	7.75 .3061	14.00 .5512	20.50 .8071	1.50 .0591	7.75 .3061	14.00 .5512	20.50 .8071
1.75 .0690	8.00 .3159	14.25 .5610	20.75 .8169	1.75 .0690	8.00 .3159	14.25 .5610	20.75 .8169
2.00 .0787	8.25 .3258	14.50 .5709	21.00 .8268	2.00 .0787	8.25 .3258	14.50 .5709	21.00 .8268
2.25 .0886	8.50 .3346	14.75 .5807	21.25 .8366	2.25 .0886	8.50 .3346	14.75 .5807	21.25 .8366
2.50 .0984	8.75 .3445	15.00 .5906	21.50 .8465	2.50 .0984	8.75 .3445	15.00 .5906	21.50 .8465
2.75 .1083	9.00 .3543	15.25 .6004	21.75 .8563	2.75 .1083	9.00 .3543	15.25 .6004	21.75 .8563
3.00 .1181	9.25 .3642	15.50 .6102	22.00 .8661	3.00 .1181	9.25 .3642	15.50 .6102	22.00 .8661
3.25 .1280	9.50 .3740	15.75 .6201	22.25 .8760	3.25 .1280	9.50 .3740	15.75 .6201	22.25 .8760
3.50 .1378	9.75 .3839	16.00 .6300	22.50 .8858	3.50 .1378	9.75 .3839	16.00 .6300	22.50 .8858
3.75 .1476	10.00 .3937	16.25 .6400	22.75 .8957	3.75 .1476	10.00 .3937	16.25 .6400	22.75 .8957
4.00 .1575	10.25 .4035	16.50 .6500	23.00 .9055	4.00 .1575	10.25 .4035	16.50 .6500	23.00 .9055
4.25 .1673	10.50 .4134	16.75 .6600	23.25 .9154	4.25 .1673	10.50 .4134	16.75 .6600	23.25 .9154
4.50 .1772	10.75 .4232	17.00 .6700	23.50 .9253	4.50 .1772	10.75 .4232	17.00 .6700	23.50 .9253
4.75 .1870	11.00 .4331	17.25 .6800	23.75 .9352	4.75 .1870	11.00 .4331	17.25 .6800	23.75 .9352
5.00 .1969	11.25 .4429	17.50 .6900	24.00 .9450	5.00 .1969	11.25 .4429	17.50 .6900	24.00 .9450
5.25 .2067	11.50 .4528	17.75 .7000	24.25 .9549	5.25 .2067	11.50 .4528	17.75 .7000	24.25 .9549
5.50 .2166	11.75 .4626	18.00 .7100	24.50 .9647	5.50 .2166	11.75 .4626	18.00 .7100	24.50 .9647
5.75 .2264	12.00 .4724	18.25 .7200	24.75 .9744	5.75 .2264	12.00 .4724	18.25 .7200	24.75 .9744
6.00 .2362	12.25 .4823	18.50 .7300	25.00 .9843	6.00 .2362	12.25 .4823	18.50 .7300	25.00 .9843
6.25 .2461	12.50 .4921	18.75 .7400	25.25 .9941	6.25 .2461	12.50 .4921	18.75 .7400	25.25 .9941

Note: The above table is approximate.

1/25.4 = .03937008

(Basis: 1 inch = 25.400 millimeters)

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