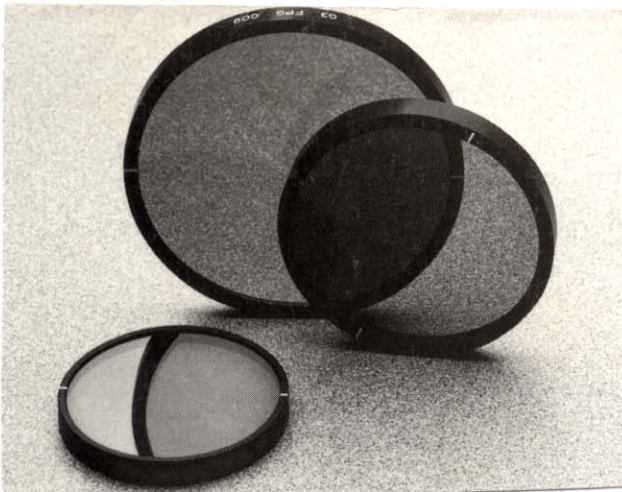


OPTICAL ENGINEERING NOTE #60 POLARIZING OPTICS TOOLS OF THE TRADE

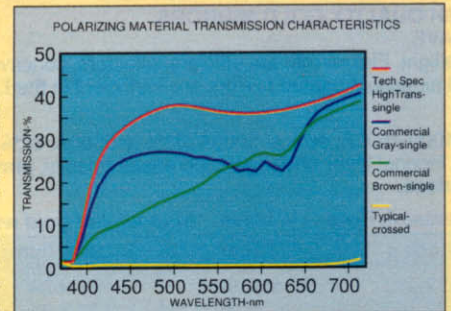
POLARIZING FILTERS Made of iodine-doped stretched polymers, they absorb radiation of one polarization vector more readily than the one at right angle to it. The basic tester to identify polarized light, or to polarize light to be analyzed. Pass the light to be studied through the filter, or look at the source through it, rotating the filter to determine the planes of polarization.



Polarizing Film Material

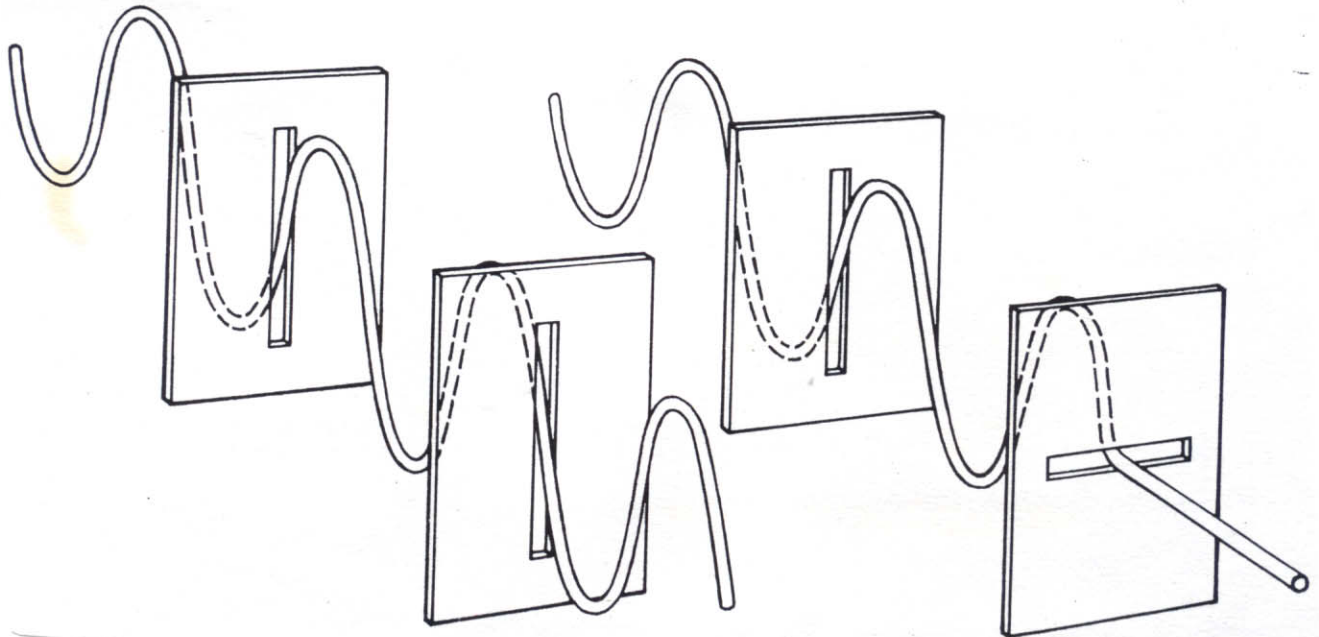
TECHNICAL SPECIFICATION POLARIZING FILM MATERIAL

Edmund Scientific uses a precision method of aligning long chain polymers to produce a remarkably efficient polarizer with extremely good color reproducibility. The polarizer is then laminated in cellulose acetobutyrate (CAB) for durability and stiffness. The High Transmittance-High Efficiency Linear Polarizer has 38% transmittance for unpolarized light. Two sheets crossed have an average extinction of 0.04%. At 550nm, the center of the visible region of the spectrum, the extinction is better than 0.01%. The sheets are a neutral gray in color. The applications for High Transmittance-High Efficiency Linear Polarizers range from microscopy to large aperture optical systems. They are also used in displays and photography. Two linear polarizers can be used as variable density filters.

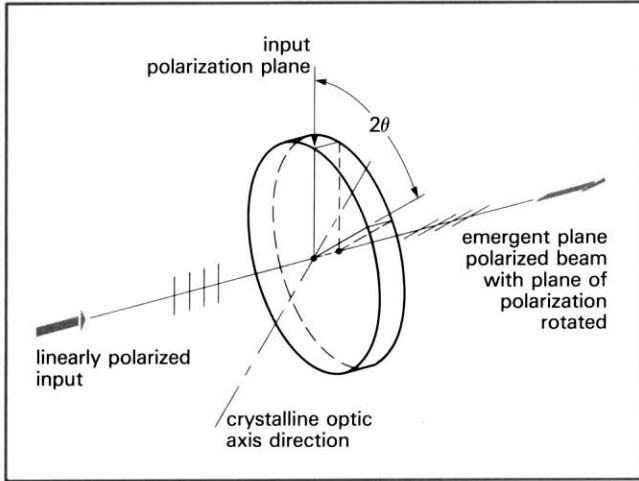


SPECIFICATIONS:

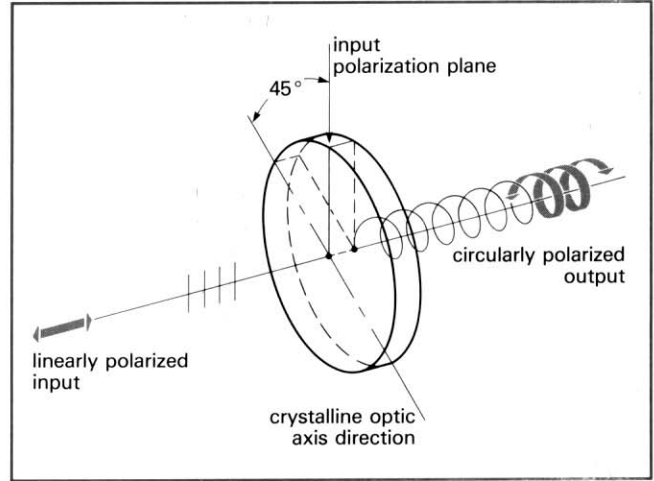
Color: Gray	Transmission: 38%
UV absorption: Greater than 99%	Dimensions: 17"x30"
Average Extinction (crossed): 0.04%	Thickness: 0.029 inch / 0.74 mm
Quality: Meets FDA impact test. Meets ANSI Z80.3 standards Meets Proposed ISO standards Can be thermoformed with standard equipment	



RETARDATION PLATES Thin slices of birefringent materials, like Mica or Quartz. They can rotate the polarization vector of linearly polarized light, as in a half-wave plate, or to circularly polarize the light in a quarter-wave plate.

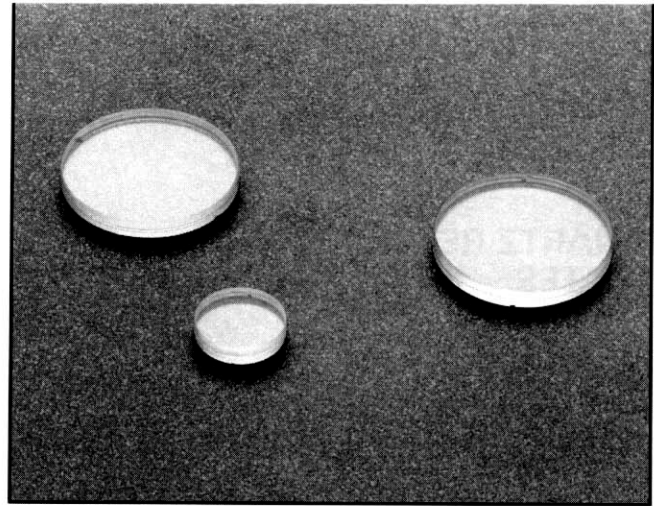


HALF-WAVE PLATE EFFECT ON LINEARLY POLARIZED LASER BEAM. The plane of polarization of the beam can be rotated at will without rotating the laser. The plane of polarization is essentially reflected in a plane containing the crystalline optic axis, and the output plane rotates at twice the angle rate of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



QUARTER-WAVE RETARDATION PLATE: The transformation from linearly to circularly polarized light (or vice versa), which occurs when the angle between the plane of linear polarization and the crystalline optic axis is exactly 45° , is shown. For other angles the transformation is from linear to elliptical (or vice versa).

How to Identify Retardation Plates: Place suspected retardation plate between two crossed polarizers; if any color or light passes through, then the optic must be rotating polarization.



POCKELS CELLS, LCD's: These are electrically controlled retardation plates. They are typically used in displays or laser Q-Switch shutters.

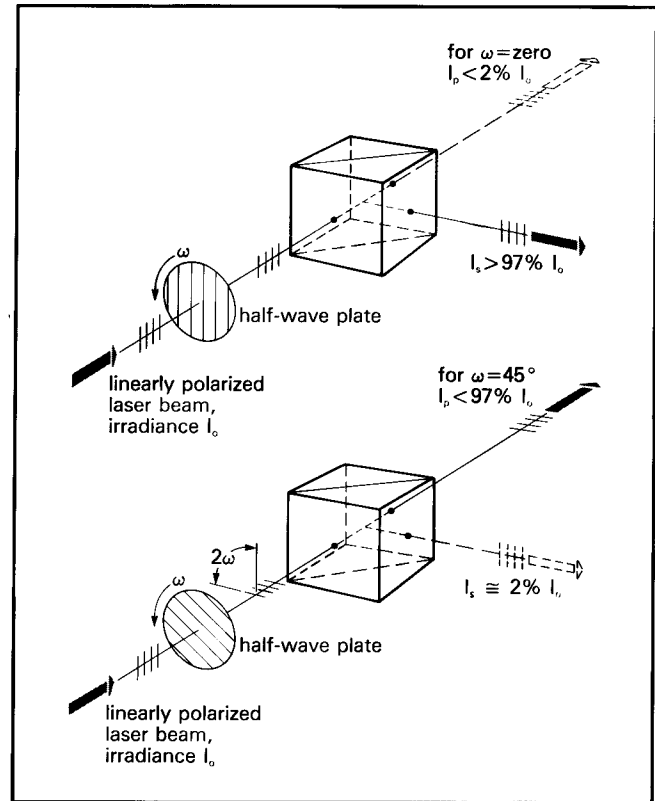
POLARIZING BEAMSPLITTING CUBES
 A beam passing through one of these units will be broken into its orthogonally oriented polarization vectors.

They look like a cube glued together from two right angle prisms; the cleave in the center has a color to it that may change with angle, as opposed to its cousin, a non-polarizing beamsplitting cube, which would have a neutral color metallic reflecting/transmitting coating applied along the hypotenuses of the constituent prism.

They come in two styles, wavelength specific, like those in disc readers, and broadband, so that many different wavelengthed laser beams can pass through the same optic simultaneously, a necessity for multiple beam multi-wavelength holography.

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.

!!CAUTION!! Notice that the two exiting 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 in holographic applications.



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_x, I_y indicated. Intermediate irradiances are seen at intermediate times.

**POLARIZING OPTICS
TRICKS OF THE TRADE**

Make a quick sketch of what is demonstrated in class.

POLARIZING LIGHT BY REFLECTION

ELIMINATION OF GLARE BY POLARIZING FILTERS

ORIENTATION OF FILTERS IN SUNGLASSES VERSUS 3-D MOVIES

TWISTING OF POLARIZATION BY STACKS OF FILTERS

**HOW TO MAKE YOURSELF DISAPPEAR WITH AN OPTICAL ISOLATOR CIRCUIT
(NON-GLARE SCREEN)**

**VIDEO DISC READER GUTS (See the Handout, OPTICAL ENGINEERING
NOTE #12.)**

**LASER Q-SWITCH (See the Handout, INSIDE JK LASERS in the LASER
UNIT.)**