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"Color filters for entertainment lighting"

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WHAT IS A COLOR FILTER?

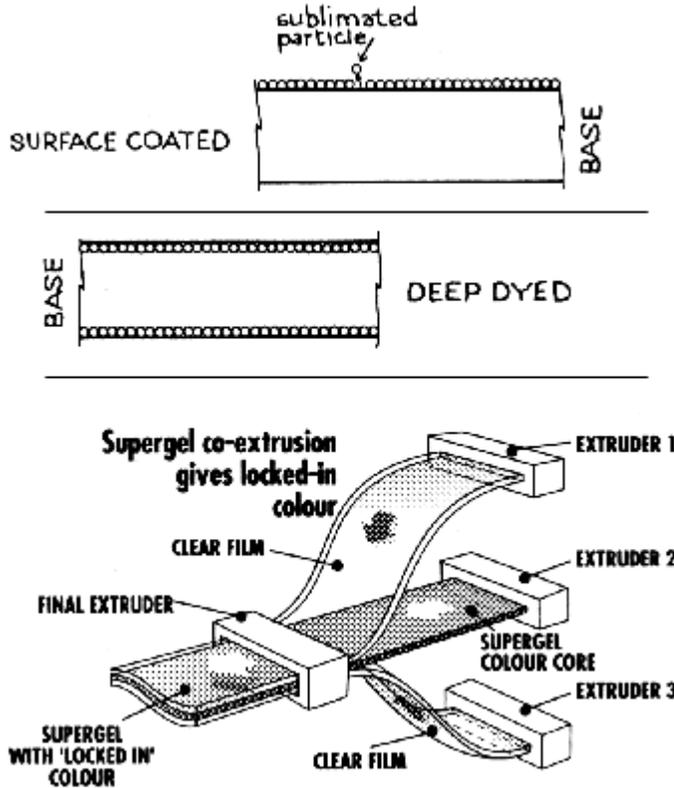
A color filter blocks passage of some portion of the visible output from any light source or light reflector by absorbing and transmitting selectively. For example, a primary red filter will allow red-associated light frequencies to pass, and block all others. Of the radiant energy which is blocked, by far the largest part is absorbed by the filter as heat.

The filter contains light refracting elements, normally dyes, which are suspended in (or coated on) a relatively transparent base. The dyes are organic, primarily aniline colorants which undergo a complex change in the manufacturing process and actually become part of the base that carries them. Integral dyes must be sufficiently heat stable to survive the high processing temperatures.

The bases were at one time dyed fabrics like silk, or gelatin derived from animal by-products. Polymer (or plastic) bases in current use include acetates, vinyls, polyesters and polycarbonates, in the approximate order of their heat stability; acetates and vinyls have the

lowest melt temperatures, polycarbonates the highest.

Figure 1. Cross-section of a filter base.



WHERE TO LOCATE THE COLORANT

There are three ways to mate color with the filter base: (1) it can be **coated on top** of the base; (2) it can be **diffused into** the surface of the base material; or (3) it can be **dispersed completely through** the base. Coating one surface of the base is easier technically. A coated filter can be recognized by scratching the surface coating with a sharp object. The color scrapes off, leaving a faulty filter.

In any color filter, the dye eventually migrates from the hottest area. The rate at which the filter fades is a function of the dye employed and the depth of penetration by the dye into the base material. When simply coated on the surface, a dye will sublime from the base into the air as a gas more easily than a dye which is uniformly locked by chemistry into the surface of the material. The greatest stability is achieved when the dye is dispersed uniformly through an extruded plastic base.

EFFECT OF DYES ON A FILTER'S MELTING POINT

The transmission of the particular dye used has a dramatic influence on the degree of heat a filter can withstand. Dark greens, for instance, absorb the rich output of reds in incandescent

light and are thus subjected to heat damage much faster than dark reds, independent of the plastic base used.

COLOR FILTER BASES POLYESTERS AND POLYCARBONATES

Of the resins available today, polycarbonate plastic offers the best combination of properties for a color filter base. It is extremely heat-stable and does not deform until temperatures in the 300° to 325°F (149° to 163°C) range are reached. It is very tough when formed into an extruded film. However, it is a most difficult material to process so that consistent thickness and dye dispersion are achieved. It requires a special combination of dye technology and plastics experience to produce this type of color medium from this difficult resin. These filters are the most heat resistant type manufactured today. Rosco's Polycarbonate filters are inherently self-extinguishing.

Rosco uses both polyester and polycarbonate plastics in their popular Roscolux range. Approximately 65% of the line is made from polycarbonate plastic. The remaining 35% are either light tint colors or colors that cannot yet be reproduced in the polycarbonate plastic and they are made from polyester. Polyester can be expected to resist deformation when raised to temperatures as high as 260° to 290° Fahrenheit (126° to 143°C).

Doubtless, even better filter manufacturing processes and materials are possible. The effort to improve Rosco products is a continuing program. Currently an average of ten new dyes are tested each week and runs of experimental resins are produced and tested long before the materials are offered on the market. Such constant concern for product improvement has contributed to Rosco's domination of color filter manufacturing technology.

If you have any specific questions regarding filter applications, we invite your inquiry at the Rosco office nearest you.

NOTES ON HANDLING AND USING PLASTIC COLOR FILTERS COMPARISONS

Keep in mind that an audience never looks at the filter itself. Instead, it sees only the filter's effect on the transmitted light. Side-by-side comparisons of filters themselves is convenient, but the best indicator of a filter's effect is the appearance of surfaces lit by the filtered light. When you have no surface colors in particular to light, use your arm or hand to check the effect on skin tones.

To study the effects of filters, try sets of gels (or two gels side-by-side) in a Carousel projector. Swatches can be mounted conveniently in 2" by 2" slide mounts.

HEAT

All plastic filters will ultimately be degraded by heat. As thermoplastics, they change dimensionally as the temperature rises at the color frame, approaching the melting point of the plastic. With extreme heats, the distortion sometimes brings the filter closer to the heat source, thus accelerating the melting and shortening its effective life. By holding the filter firmly at four or more points around the frame opening, the plastic will retain its shape through

slightly higher temperatures. Ideally the filter should be held all around the frame perimeter for best retention and longest life.

The illustration (Fig. 2) shows a typical stress pattern seen on a polyester filter. Polycarbonate material will show the pattern less, but similar stresses will be present in all types of plastic filters when heated.

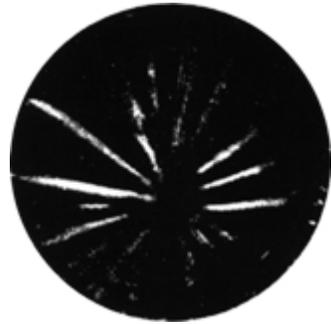
If your fixture operates with excessive temperatures at the filter frame (most easily recognized a when filters sag in the frame), try fastening the filter down all around with double-faced polyester tape. Or drill addition holes in the filter frame and use brass paper fasteners at four or more points.

Figure 2. Stress Pattern From Heat in a Typical Polyester Filter

DOUBLING

Two or more layers of lighter (higher value) filters may be used to produce a darker or more intensely colored light beam. However, the combination will be significantly less efficient than a single filter.

The inside surfaces between the two layers will form an insulating barrier, and become hotter than the outside surfaces. The net result may not be desirable when the filter is used in a hotter fixture. Instead of sandwiching the two filters try Rosco's Dual Filter Frame holder (Fig. 3).



SAMPLE BOOKS

All color manufacturing is subject to subtle variations in colorant chemistry from one product to the next. Whether it be printed wallpaper, house paint, artist's oils or color filters—the finished product does change over considerable time spans. In filter production, new color dyes are added, basic dyes are changed or discontinued, and more heat-resistant dye formulations are adopted. The alert light designer, if he is active in his profession, exchanges his gel sample book with the manufacturer about once every three years. At Rosco, it is the policy to make an exchange at any time on request.

TROUBLESHOOTING PROCEDURES

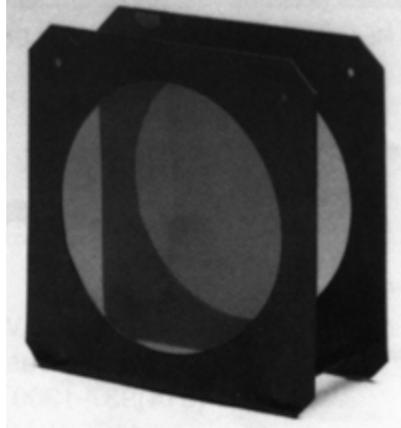
If a gel fails prematurely in a fixture, first check that the fixture has the voltage and wattage lamp for which it is designed.

Check the general alignment and assembly of the fixture. Often a filter may be placed at a beam cross-over and a small focusing adjustment or movement of the filter will solve the problem.

USING A HEAT SHIELD BETWEEN LAMP AND FILTER

Special formulations of clear glass and plastics exist which may be employed specifically to absorb or reflect infrared emissions (heat) before they reach the color filter. Rosco's Heat Shield and ThermaShield are two such filters. The Heat Shield or ThermaShield must be placed so that there is an air space on both sides of the filter to allow an escape for the convected heat. Do not sandwich two filters together in one holder. This will cause premature failure of both filters. We recommend the use of the Rosco Dual Frame holder when using two filters in a fixture. See Fig. 3.

Figure 3. Dual Frame Holder



The Heat Shield product is a clear film. The resin of this plastic can take a continuous operating temperature nearly twice that of either the polyester or polycarbonate plastic. It protects the color filter by blocking the convected heat. It does not block the infrared energy, however, and therefore is not as effective as the ThermaShield. The ThermaShield has a vacuum deposit multi-layered coating designed to reflect the infrared energy that destroys color filters. The ThermaShield is especially practical for lamps that are hung in hard to reach locations or when proper maintenance of the color filters is not available.

For additional information on Rosco's Heat Shield and ThermaShield filters, please see Rosco's Application Note "Protective Filters."