

Fujicolor Higher Speed Negative Film and Improved Positive Film

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Two new Fujicolor films, a negative and a print film, are presented. The negative, designated as Fujicolor Negative Film A 250 (types 8518 and 8528, in the 35-mm and 16-mm formats respectively), has an exposure index 250 speed rating under tungsten illumination. Its structure, speed under various lighting conditions, sensitometry, and other characteristic properties are described and illustrated. The Fujicolor Positive Film HP (types 8814 and 8824, in the 35-mm and 16-mm formats respectively) is similarly commented on.

New Positive Color Stocks

Fujicolor negative film A250 (35-mm type 8518 and 16-mm type 8528) is a high speed tungsten type motion picture color negative film with an exposure index of 250. It provides not only high speed but features also fine grain, high definition, natural color reproduction, and a wide exposure latitude. It is suitable both for indoor and outdoor work, but it is especially useful where lighting levels are low. Furthermore, an actual effective exposure index of 500 can be obtained through forced processing, thus providing for an even wider range of photographic applications. Processing is the same as with the current Fujicolor negative film, and it can be processed in the Eastman Kodak ECN-2 process without modification.

Film Structure

The film structure starts with a safety base and continues (bottom to

top in Fig. 1) with an antihalation layer, a red sensitive emulsion coating (three layers), an interlayer, a green sensitive emulsion coating (three layers), a yellow filter layer, a blue sensitive emulsion coating (two layers), and finally a protective layer. As with the current type, the antihalation layer is placed between the base and the emulsion coatings so as to provide not only a positive antihalation effect but also to minimize edge fogging during daylight loading. Therefore, the film can be handled, notwithstanding its high speed, in the same manner as the current type. In addition, the design of both the protective layer and the backside of the base provide antiscratch and antistatic properties. A newly developed matting agent has been included in the protective layer to eliminate Newton's rings during printing and greatly reduce surface-to-surface adhesion.

Film Speed

Exposure indexes are 250 for tungsten light (3200 K) and 160 for daylight. The film is balanced for light sources with a color temperature

of 3200 K with no need for light balancing filters. Under general daylight conditions the use of light balancing filters such as the Fuji filter LBA-12 or the Kodak daylight filter No. 85 is required. For photographic work involving subjects illuminated with fluorescent light sources, reference should be made to the filtering and exposure indexes shown in Table 1. The improvements of the spectral sensitivity characteristics of the film have reduced the need for light balancing filters and provide higher effective film speed ratings with filters in place.

Until recently, it has been very difficult to increase the film speed of motion picture color negative films. One of the reasons for this is related to the fact that tungsten light contains a relatively limited blue light component, and thus the blue sensitivity of tungsten type film must be raised to a particularly high level in comparison to daylight type film of the same speed. A further problem resides in the fact that when comparing still photography color negative film with motion picture color negative film in regard to color developer activity, the

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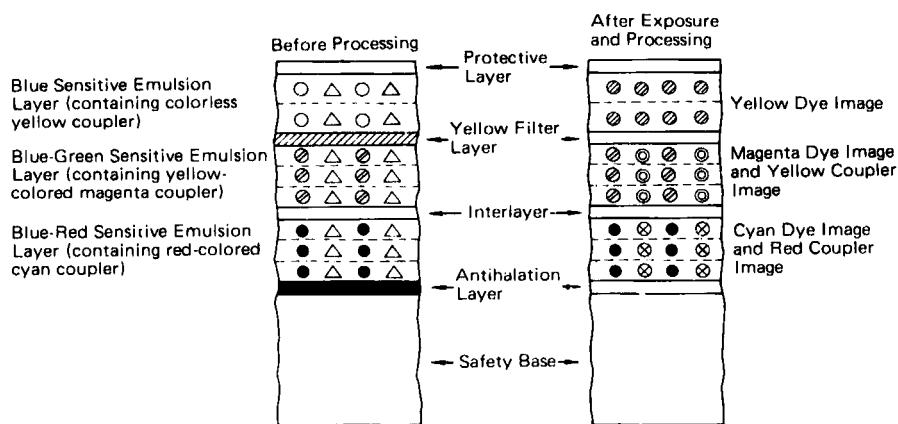


Figure 1. Structure of the new Fujicolor negative film.

Table 1—Filters and Exposure Indexes under Fluorescent Lighting

Lamp Type	Recommended Filters	Exposure Index
Full color rendering white fluorescent lamp	Fuji LBA-8 or Kodak daylight filter No. 85C	200
Normal color rendering white fluorescent lamp	CC-20R	200
Daylight type fluorescent lamp	Fuji LBA-12 or Kodak daylight filter No. 85	160

motion picture film developer is found to be less active. The latest advances in emulsion and manufacturing technology incorporated in the new Fujicolor negative film have eliminated all these limitations or restrictions.

Characteristic Curves

The characteristic curves for Fujicolor negative film A250 types 8518 and 8528 are shown in Fig. 2. Tone reproduction from the highlights through the shadow areas, and color reproduction, especially flesh and gray tones, were verified through full application of actual photographic testing from which the film design was determined. The results are expressed in the characteristic curves. Furthermore, much thought has been given to provide this high speed film with a wide exposure latitude so that even when a mistake is made exposing the film at E.I. 100, no practical problems will result. In the same way, even with the one stop underexposure, that is with an E.I. 500 exposure, no practical problems will result. However, with the 16-mm version of the film, grain becomes noticeable in shadow areas, so it is important to avoid underexposure.

Compared with the current type, tone reproduction results in a slightly more contrasty image, but for photographic purposes under low light levels where insufficient shadow density is a problem, such reproduction is desirable.

Color Reproduction

In the new material, the same natural color reproduction has been re-

tained as that of the current Fujicolor negative films types 8517 and 8527. A loss of color purity, often seen with high speed color films, has been effectively avoided. A comparison of the new material with the current type shows no fundamental differences in color purity except for improvement in flesh and gray reproduction. The new film has been designed to result in a slight decrease in flesh-tone reds (Fig. 3).

Spectral Sensitivity and Spectral Density

Slight changes have been made in the spectral sensitivities (Fig. 4) of the red and green sensitive emulsion layers for the purpose of improving flesh tones and the gray color balance, and for decreasing color shifts when working under fluorescent or mixed light sources. This results in a very natural rendering of colors. In addition, when exposing the new material under mixed light sources, such as found under existing light conditions or in cases where qualitatively different supplementary lighting has been provided, or under extremely low light level situations, the new material shows very little differential response to the most diverse light source qualities when compared to the current type of color negative. As to spectral density, the magenta distribution has been somewhat narrowed and the cyan peak somewhat

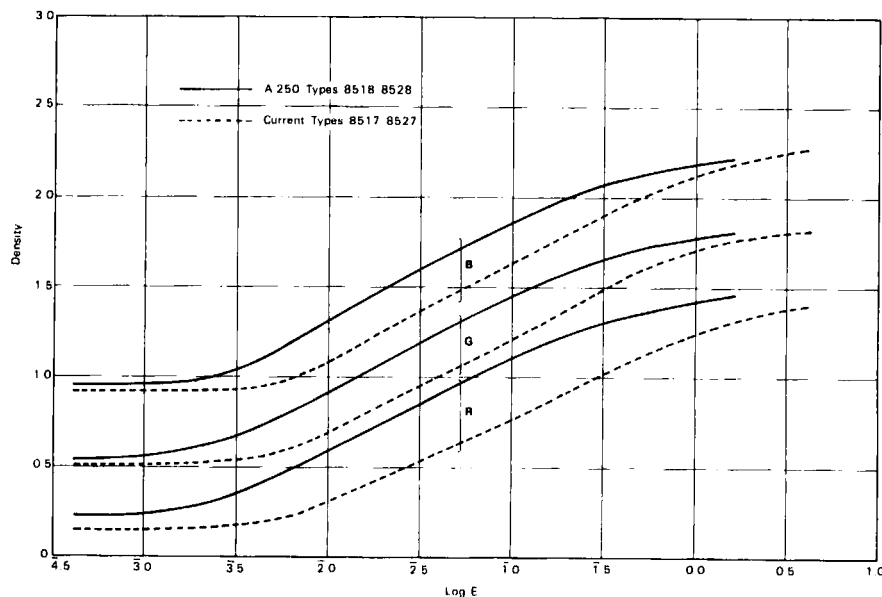


Figure 2. Sensitometric curves of the new and the current negative films.

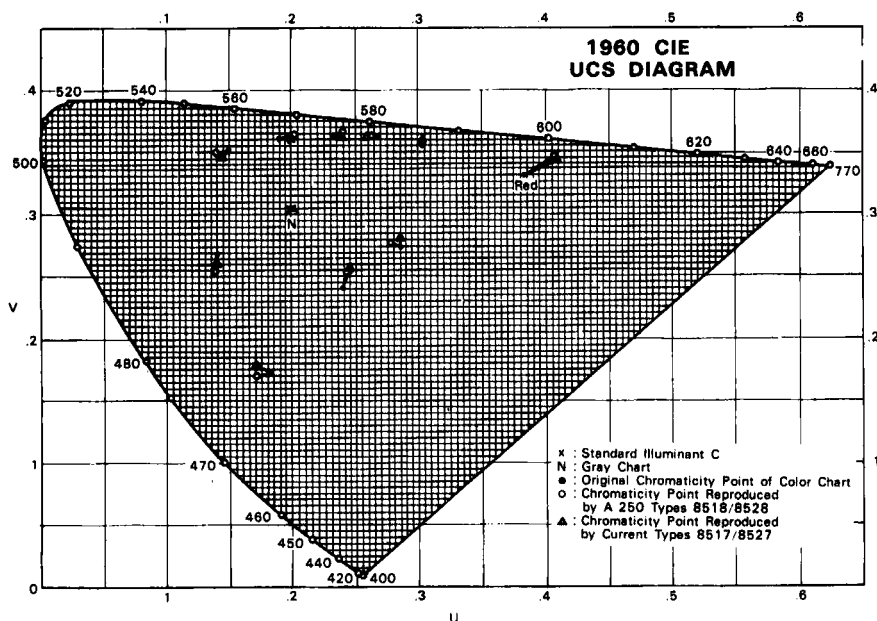


Figure 3. Color loci of a set of standard colors on the CIE UCS diagram and their reproductions by the new and the current color negative film.

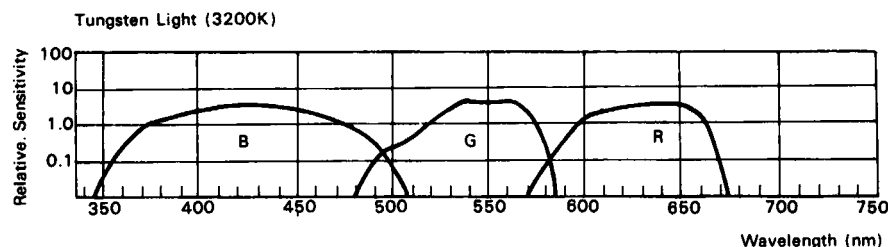


Figure 4. Spectral sensitivities of the new negative film.

shifted toward the shorter wavelength end of the spectrum, resulting in slight differences relative to the current film (Fig. 5).

Graininess and Sharpness

The values derived for RMS (Root Mean Square) granularity are shown in Fig. 6. There is a direct and inseparable relationship between film sensitivity and graininess. However, a film cannot be considered as a first rate quality material if the graininess has deteriorated because of efforts made to increase the film speed. For high speed films, the balance between sensitivity and graininess is especially important. The graininess of Fujicolor negative film A250 is, to some degree, coarser than the current Fujicolor negative film types 8517 and 8527. However, comparing the grain of the current film after forced processing to double the effective film speed, the grain quality levels of

both film are about the same. Grain quality differences have been determined on the basis of physical precision measurements, but when the new material is projected and viewed in 35-mm projection at normal viewing distances by means of a print made from a CIM duplicate, it is impossible to detect any differences in quality among the two materials.

In comparison to the earlier Fujicolor negative film type 8516 (E.I. 100), which was quite popular — placed on the market between 1971 and 1977, the grain quality of the new Fujicolor negative film A250 is far superior. This must be attributed to the great strides in emulsion technology made over the past few years.

The sharpness level, compared to the current film, is very favorable. Figure 7 indicates the CTF (Contrast Transfer Function) or spatial frequency characteristics for Fujicolor negative film A250 and the current

film. As can be seen, there are no appreciable differences. This data expresses the spatial frequency characteristics of the film itself. Lens openings near the maximum aperture must be used under low light level conditions. With the Fujicolor negative film A250 the lens can be stopped down one stop and a third, thereby increasing the effective visual sharpness.

Processing

The new film is designed for processing with exactly the same formulas and under the same conditions as the current material, without any modifications. Limited changes in the amounts of chemicals that make up the color developer or small differences in pH values have little or no effect, because the film was carefully designed for increased processing stability. This has been verified through a survey of processing laboratories in the U.S., in various European countries, and in Japan. There were no indications that the film's high speed was causing specific processing instabilities.

Fujicolor negative film A250 has been created with particular attention to best results under forced processing conditions. If the new film is force-processed under exactly the same conditions used to double the effective film speed of the current film, an effective speed increases to E.I. 500 is obtained. No visible contrast mismatching or color shifting will result from such processing.

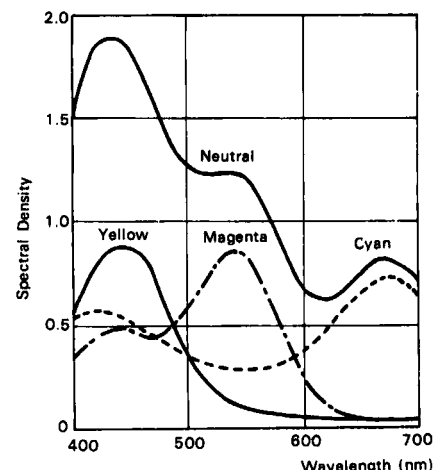


Figure 5. Spectral density curves of the dyes of the new negative film.

Table 2—Safety Limits for Airport X-Ray Exposure

Film Type	Safe Number of X-Ray Checks
Fujicolor negative film A250 Types 8518 and 8528	4
Fujicolor negative film Types 8517 and 8527	8

Note: A single X-ray check amounts to 0.3 milliroentgen.

However, some adverse graininess effects may be noted. In addition, with forced processing and some degree of underexposure, shadow area graininess will be adversely affected, and care must be exercised in this regard.

Physical Properties

Not only the photographic qualities of this new film have been thoroughly researched, developed, and tested, but also its physical properties. This is noticeable especially through the disappearance of static marks, likely to occur as film sensitivities are increased. With regard to edge fogging under daylight loading conditions, the new film has been designed so that it can be handled in exactly the same manner as the current E.I. 100 film.

Handling Raw and Exposed Films

As with all other color films, Fujicolor negative film A250 experiences some degree of change in photographic properties when stored over extended periods of time. Because these changes will be accelerated especially under high temperature and humidity conditions, the storage of rawstock should take place in the original packaging and at temperatures below 10°C (50°F). Film that has been stored under refrigeration must remain tape-sealed in the original packaging and allowed sufficient time to reach room temperature. Exposed film, like all other films, should be processed as soon as possible after exposure to reduce latent image fading. If immediate processing is not possible, refrigerated storage is essential until processing can be carried out. Fujicolor negative film A250 can be handled in exactly the same manner suitable for other color films. However, this film is

quite susceptible to the effects of X-rays because of its high speed. Thus, for the purposes of airport baggage security procedures, the safety limits indicated in Table 2 must be observed. If this should not be possible, a carrying-case designed to protect films against X-rays must be used.

Handling Processed Film

Like all current films, Fujicolor negative film A250 has been designed so that the image forming dyes have the inherent ability to withstand long-term storage. Archival storage though is impossible, and for long-term storage purposes protection against high temperatures and humidities is required to inhibit fading. This requires that storage temperatures be maintained below 20°C (68°F) and at relative humidities between 40 and 50%.

Edge Marking and Identification

The Fujicolor negative films A250,

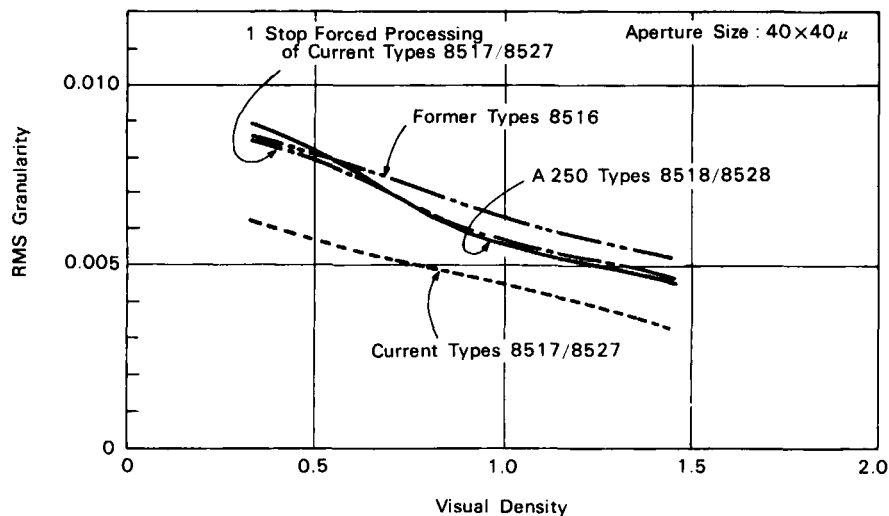


Figure 6. RMS granularity characteristics of the new, the current, and the former negative films.

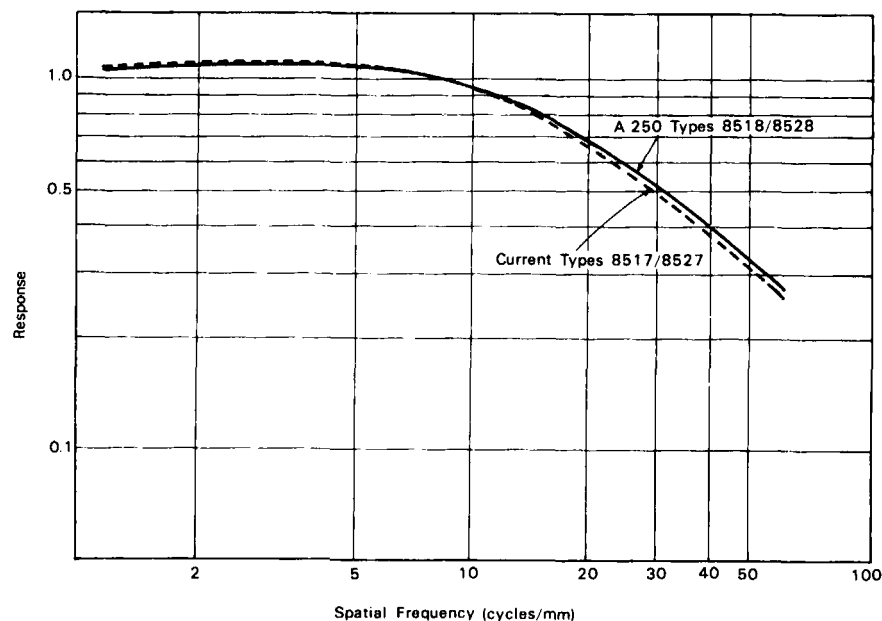


Figure 7. Modulation transfer characteristics of the new and the current negative films.

types 8518 and 8528, carry the product designation "N8" printed as a latent image. The current product is identified in the same manner by the code "N7". The footage numbering orientation is the same as with the current product. Furthermore, raw-stock samples of the current product and the new Fujicolor negative film A250 can be distinguished from each other by the color of their unprocessed emulsion surface. The high speed film has a reddish brown color while the current film is yellowish brown in color.

Perforation Types and Packaging

The 35-mm film has type N (type BH) short pitch perforations, while the 16-mm film has either single or double perforations, both also of the short pitch type. Roll lengths are indicated in Table 3.

Table 3—Available Packagings of Fujicolor Negative Film A250

Format	Roll length in ft (m)	Core Type
35 mm	200 (61)	35P2
35 mm	400 (122)	35P2
35 mm	1000 (305)	35P2
16 mm	100 (30.5)	Daylight loading camera spool
16 mm	200 (61)	Daylight loading camera spool
16 mm	400 (122)	16P2

Note: The 35-mm stock has BH-1866 (N-4.740 mm) perforation; the 16-mm stock is available with 1R-2994 (1R-7.605 mm) or 2R-2994 (2R-7.605 mm) perforation.

Summary

As can be seen from the foregoing discussion, the new negative film exhibits a number of special characteristics that provide for a wide variety of special applications.

1. The existing light shooting possibilities have been greatly expanded, allowing for use in a greater variety of locations and under a larger variety of conditions. This is especially true with

locations where previously filming was impossible without bringing in extra lights. Consequently, daylight filming possibilities have also been greatly expanded. The use of fast lenses and the application of forced processing will expand the cinematographic possibilities of this film to still wider limits.

2. In production on the studio set, the closing down of zoom and anamorphic lenses has become possible for obtaining even sharper images. Panfocus cinematography is also greatly enhanced.

3. For photographic subjects where the application of strong lighting is not desirable, it is now possible to produce good cinematographic records with low illumination levels.

4. High speed motion picture work is greatly enhanced with the use of this new film.

5. Also, when pursuing a moving photographic object with a handheld camera and a stopped down lens for greater field depth, the possibility of incorrect focus during filming is substantially reduced.

6. The amount of filtration required with fluorescent lighting has been reduced, and thus wider photographic applications under these conditions are now possible through the retention of high speed characteristics.

7. Finally, the use of this film also allows greater economies through the reduction of energy usage for lighting purposes.

New Positive Color Stocks

The Fujicolor positive films HP (35-mm type 8814 and 16-mm type 8824) take the place of the current Fujicolor positive HP films, types 8813 and 8823. They have been improved in tone and color reproduction

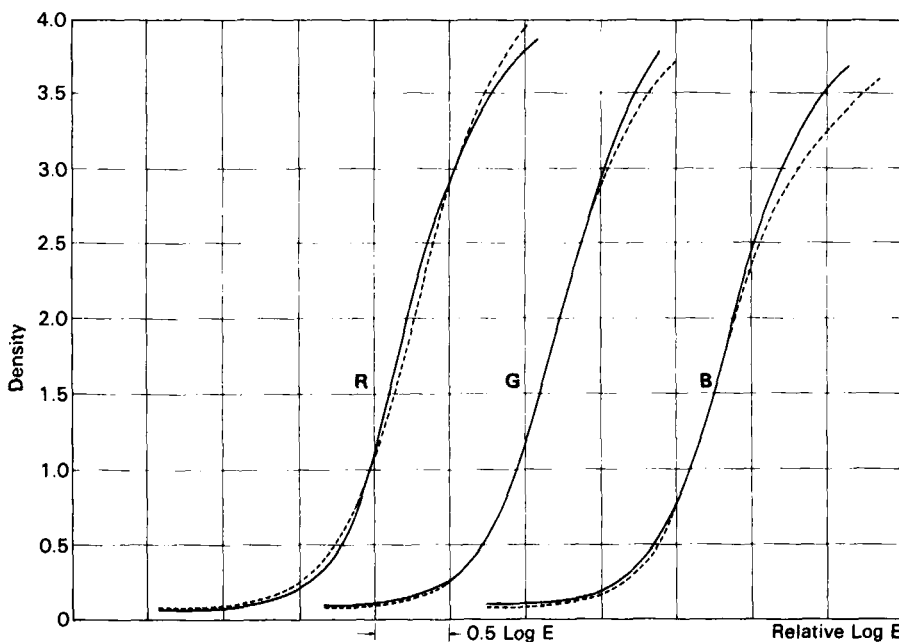


Figure 8. Sensitometric curves of the new and the current Fujicolor positive film. (Solid lines: types 8814/8824; dashed lines: current types 8813/8823.)

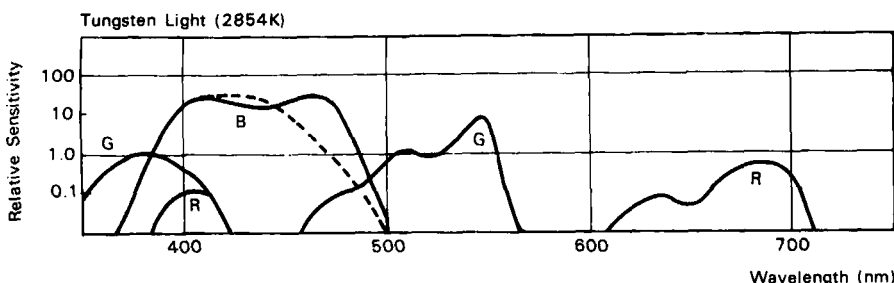


Figure 9. Spectral sensitivities of the new and the current positive film. (Solid lines: types 8814/8824; dashed lines: current types 8813/8823.)

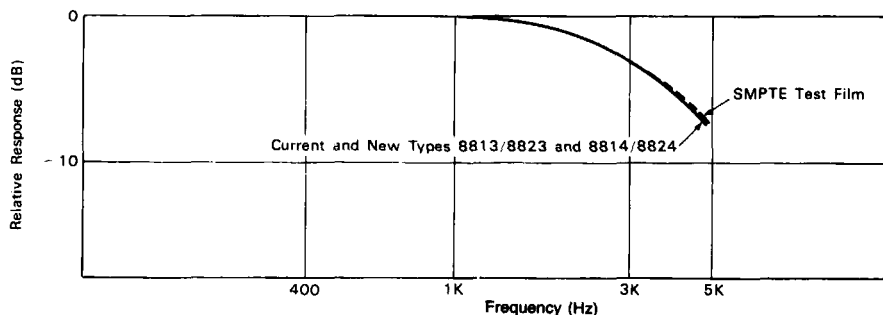
in the highlight and deep shadow areas, flesh tones and neutral reproduction, and film speed.

Improvements in Tone Reproduction

Changes have been made in the highlight contrast of the blue sensitive and red sensitive layers for obtaining a softer tone and more neutral grays. Also, the shadow contrast in each of the layers has been increased as has the deep shadow density. This, in combination with improved color balance, has brought about reproduction of good neutral blacks. Figure 8 shows a comparison between the characteristic curves of the new and the current Fujicolor positive films. To make the differences more visible, the R, G, and B curves have been separated from each other by a distance of 1.0 log E at the D = 1.0 density level.

Improvements in Color Reproduction

Special consideration was given to the reproduction of the range from flesh tones to neutral tones. For this, some modifications were made in spectral sensitivity and tone characteristics (Fig. 9). As a result, when color timing is adjusted for proper reproduction of neutral grays, the flesh tones will not become too red. Apart from this change, the yellow color has been shifted toward a more lemon yellow hue, and the other colors are maintained without any difference from the current Fujicolor positive HP film.



	Negative Visual Density	Positive I.R. Density
New Types 8814/8824	2.30	1.20
Current Types 8813/8823	2.30	1.20

Figure 13. Frequency response characteristics of the new and the current positive films.

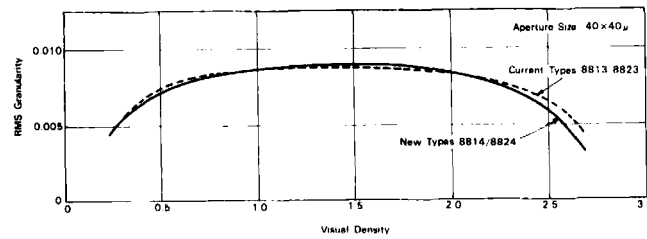


Figure 10. RMS granularity characteristics of the new and the current positive films.

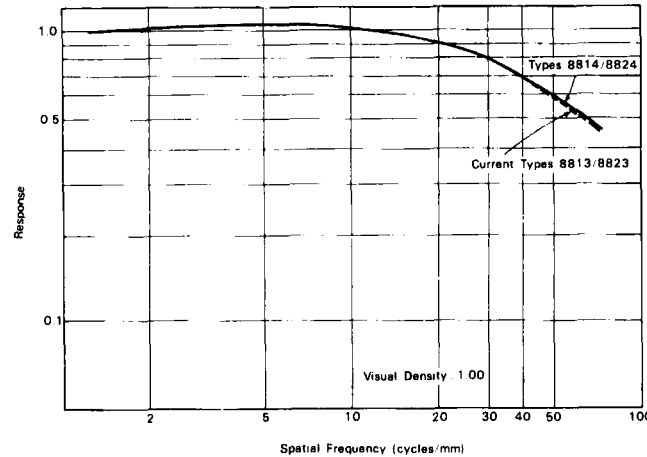


Figure 11. Modulation transfer characteristics of the new and the current positive films.

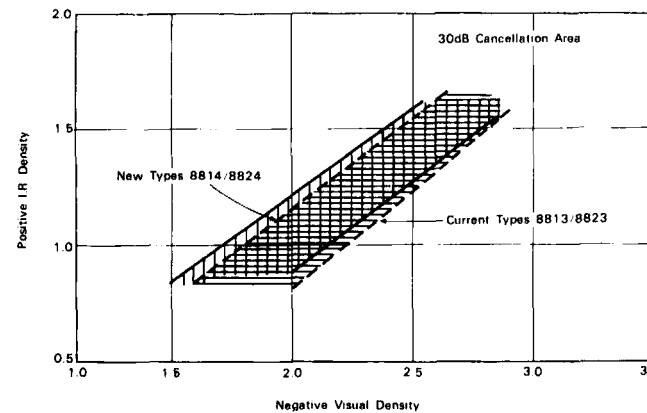


Figure 12. Cross modulation distortion characteristics of the new and the current positive films.

Improvements in Film Speed

For the special purpose of increasing printer speeds and light source color temperatures, the sensitivity of

the blue sensitive layer has been increased by 0.15 log E over that of the current type.

Processing

As with the current type, the new type of color positive film has been designed for use in high temperature and high speed processing systems (process ECP-2). Changes in photographic properties resulting from shifts in processing conditions remain very limited, as is the case with the current film. When a persulfate bleach is used with the current film, the deep shadow density of the red sensitive layer (cyan layer) has a tendency to decrease, but this tendency has been corrected in the new film. As with the current type, the

Table 4—Available Packagings of Fujicolor Positive Film HP

Format	Performance Type and Pitch	Row Order	Roll Length in ft (m)	Core Type	Winding
35 mm	KS-1870; P-4.750 mm	—	2000 (610)	35P3	—
35 mm	KS-1870; P-4.750 mm	—	3000 (915)	35P3	—
35 mm	KS-1870; P-4.750 mm	—	4000 (1220)	35P3	—
35/32 mm	2R-3000, 2R-7.620	—	3000 (915)	35P3	—
35/16 mm	3R-3000; 3R-7.620 mm	1-3-0	2000 (610)	35P3	A or B
16 mm	1R-3000; 1R-7.620 mm	—	2000* (610)*	16P3	A or B
35/8 mm Type S	5R-1667; 5R-4.234 mm	1-3-5-7-0	3000 (915)	35P3	A or B
16/8 mm Type S	2R-1667; 2R-4.234 mm	1-3	2000* (610)*	16P3	A or B
16/8 mm Type S	2R-1667; 2R-4.234 mm	1-4	2000* (610)*	16P3	—
16/8 mm Type R	2R-1500; 2R-3.810 mm	1-4	2000* (610)*	16P3	—

*Supplied with two rolls per package.

new film can be processed without a stop bath, but in such cases the wash after the color developer step has to be kept to a minimum and it is necessary to maintain the pH of the first fixer at 4.25 ± 0.2 .

Other Properties

Film structure. The structure is similar to that of the current type. There is the safety base on which a blue sensitive layer is coated, then an interlayer, followed by a red sensitive layer, another interlayer, a green

sensitive layer, and finally a protective layer. The reverse side of the base carries a black antihalation coating.

Film storage properties. As with the current type of positive rawstock, latent image keeping properties and dye stabilities have been thoroughly researched, and changes due to long term storage have been kept to a minimum. The dye stability of the new film remains the same as that of the current type, even without the use of formaline in a stabilizer.

Image quality. The grain quality and sharpness characteristics are the same as those of the current type of positive film, retaining fine grain and high sharpness (Figs. 10 and 11).

Sound record characteristics. The same soundtrack characteristics that exist in the current type are retained in the new film (Figs. 12 and 13).

Perforation types and packaging. The new film is supplied with perforation and packaging orientations indicated in Table 4.

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SMPTE Biographical Sketch

Charles E. Anderson, Advanced Product Planner in the Audio-Video Systems Division of Ampex Corporation, is the thirty-second President of the Society of Motion Picture and Television Engineers. He has been with Ampex since 1954 and was one of the original members of the videotape recording team.

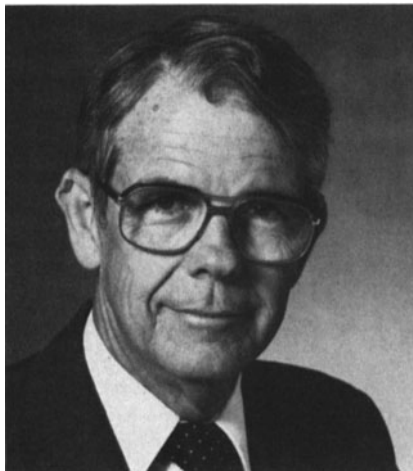
"At Ampex I was lucky enough to be assigned to a small group of engineers trying to develop a videotape recorder. Somewhat to our surprise after the doubts and the difficulties, the videotape recorder worked. We hardly realized then that communication world-wide had taken a giant step forward."

Anderson was born in Long Beach, California, served three years with the U. S. Army (1943-1946), attended Case School of Applied Science in Cleveland, Ohio, returned to Southern California following graduation (1948) and, in 1954, he joined Ampex and moved to the San Francisco area.

Before joining Ampex, he was with ElectroCircuits Inc., as Chief Engineer and with Consolidated Engineering as an engineer. Both firms were located in Pasadena, California.

His work on the first videotape recorder was, primarily, development of the FM signal system. In his present post of Advanced Product Planner, he is involved in the selection of new television products and technologies to be developed and marketed by the Audio-Video Systems Division.

A member of the SMPTE since 1958, Anderson became a Fellow in 1967. He was a Governor for four terms and has served the Society in many other ways. For example, he was head of the Standards Committee for four years. He was an original member of SMPTE's Videotape Recording Committee and served four years as its chairman. He is currently a member of the New Technology Committee. He served a two-year



Charles E. Anderson

SMPTE President

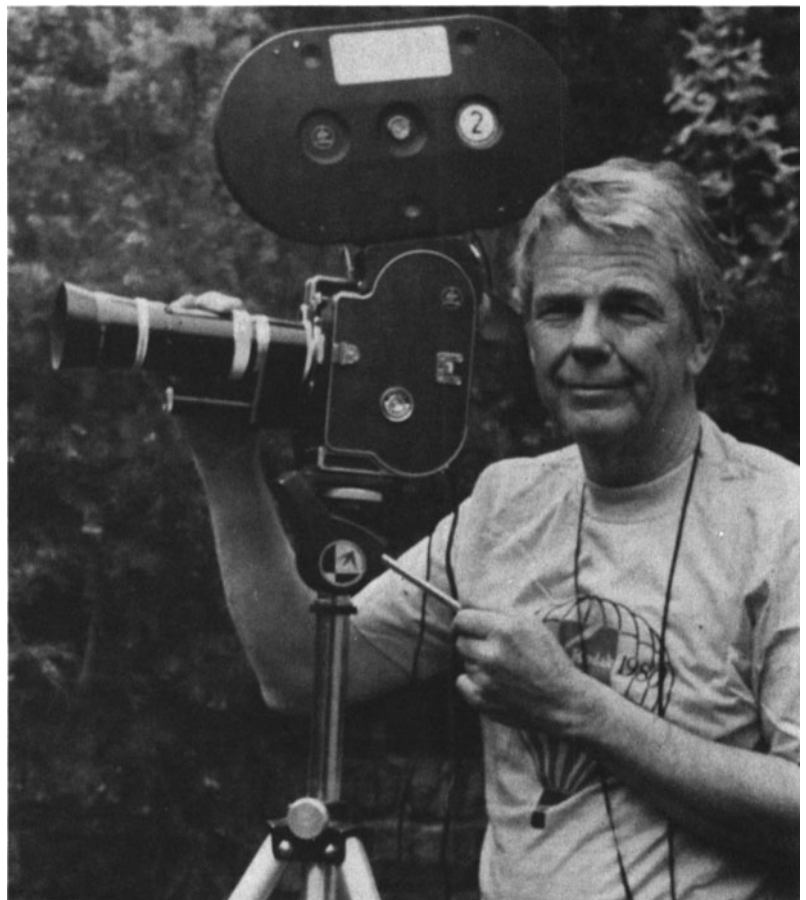
1981-1982

term as Executive Vice-President before being elected President.

In his acceptance speech following his election to the Presidency, Anderson emphasized that the SMPTE is, first of all, a technical society concerned with motion pictures and television; second—through its Conferences, the *SMPTE JOURNAL* and the Section meetings—the Society

provides a forum for the exchange of technical information and ideas; and third, the Society provides the means whereby the national and international standards that serve the motion picture and television industries can be generated.

He has high aims and hopes for the SMPTE which has grown from ten members when the Society was



Charles
Anderson
amateur
filmmaker.

Charles E. Anderson on the road: as the chief executive of the SMPTE, President Anderson may travel over 10,000 miles a month, spreading the gospel of motion picture and TV technology.



founded in 1916 to an international organization of more than 9,000. "It is a serious trust that has been placed upon us," Anderson said. "The SMPTE is an organization which has not only encompassed and adapted to the enormous technological advances of recent years, but has been influential in bringing about many advances." Anderson also stressed the unity of the Society, noting all its members have access to its many services.

Charles Anderson leads a full life with many interests. His main interests are, of course, Ampex and the SMPTE, but his hobbies provide balance, color, and zest to a well-rounded life. When he was younger, aviation and flying were his major passion. He flew his own plane, a Debonair (a Beech plane) for a number of years with no mishaps. "A most enjoyable time," he recalled.

Currently he is interested in the historical aspects of commercial air-

lines and airliners. He is the author of "The Martinliner" published in the *Journal of the American Aviation Historical Society*, and "Philippine Clipper," a gripping story of the Philippine Clipper's heroic struggle on December 8, 1941.

A complex personality, Anderson is a dynamic, highly competent man, able to perform with high efficiency in an extremely demanding job—in fact, two jobs, that of SMPTE President in addition to his heavy responsibilities at Ampex. On the other hand, there is an Anderson who feels the need of solitude and contemplation. He told us, "I spend as much time as possible at a cabin I own up in the Sierras in the heart of the Gold Country. In fact, one of the reopened gold mines, The Blazing Star, is just two miles from the cabin. One way to get away from the pressures of daily life is to sit and watch the trees grow and the boulders move."

One of Anderson's on-going hobbies is that of amateur filmmaking. Most of his films are about trains and run for 10 to 15 minutes. They are shown regularly to train buffs.

STANDARDS AND RECOMMENDED PRACTICES

Proposed American National Standards

Two Proposed American National Standards are published here for a trial period and public review: V98.29M, Basic System and Transport Geometry Parameters for 1-in Type B Helical-Scan Video Tape Reference Recorders for Video and Audio Reference Tapes; and V98.30M, Dimensions and Location of Records on Video and Audio Reference Tape for 1-in Type B Helical-Scan Video Tape Recorders.

Proposed SMPTE Recommended Practice

A Proposed SMPTE Recommended Practice on the 1-in Type B format is also published for review: RP 107, Video and Audio Reference Tape for 1-in Type B Helical-Scan Format.

Approved SMPTE Recommended Practices

Two SMPTE Recommended Practices were approved by the Society's Board of Governors on November 9, 1980: RP

94-1980, Gain Determination of Front Projection Screens; and RP 95-1980, Installation of Gain Screens. SMPTE Recommended Practices are available from Society Headquarters for \$1.50 each.

Approved International Standard

The International Organization for Standardization (ISO) recently approved an International Standard, the technical content of which is published here for your information. ISO 5760-1980, Cinematography — Sound Motion-Picture Camera Cartridge, 8-mm Type S, Model 1 — Aperture Opening, Pressure Pad and Film Position — Dimensions and Specifications, is in agreement with American National Standard ANSI PH22.198-1980.

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