

Film Stocks Used for Optical Special Effects

By Roy Field and Tony Iles

This article describes the wide range of film stocks used for optical special effects work in motion pictures. The use of traveling mattes and painted mattes is discussed, as well as the problems of matching contemporary work with that from archival sources. The properties of the various films used are described, together with reasons for their selection and application. The article is illustrated with examples from various films employing optical trick photography.

Such motion pictures as *Superman*, *The Great Muppet Caper*, and *The Dark Crystal*, illustrate the tremendous debt the special effects workers owe to the manufacturers of the basic film materials that are used. Continuing developments in camera negative and print film stocks have made available theatrical picture quality so high that we have come to take it for granted.

Optical Trick Photography

Optical trick photography is being used more than ever before, to enhance the composition of feature films. It is a vital element in simulating the thrilling and marvelous feats that audiences love, such as the exploits of fantasy heroes like Superman. But good optical trick work has to be invisible. This calls for great care and expertise in operation, and also the availability of a wide range of different types of film stock, to meet each special process requirement.

Surprisingly, there are more than a dozen different film grades in current regular use for optical trick photography. They all have different properties, and perform different jobs for us, often far from the purpose for which they were originally designed. Only one manufacturer, Eastman Kodak, has built up the resources to offer the complete range of film stocks that we need.

Applications

Recent feature films illustrate a range of different applications, as follows:

The Fantasy World

The first example is *The Dark Crystal*, a fantasy film produced by Jim Henson and Gary Kurtz. This is an obvious case of the need for optical work, as it takes place in an imaginary world, populated by a set of imaginary characters, all invented by Jim Henson, creator of "The Muppets."

The little hero, Jen, is only two feet, nine inches tall, and because Jim Henson and his associate, Frank Oz, wanted their creatures to be in a totally new world, it was necessary to shoot even the exteriors as interior sets.

Let us consider a typical scene from the movie, taking it from its script

number to the finished negative:

Script Scene No. 25 (Fig. 1), *Dark Crystal* — Day; Exterior; Aughra's Mountain. A dark purple crystal hangs from the talons of a bat-like creature — Batbird, which is watching Jen climb the cliff, while Aughra's Observatory towers high above, against a turbulent sky.

Because of differences in scale, and separate focus requirements, the four components shown on the art director's diagram were shot separately. These were: "Batbird," in the foreground, against a background made up of "Jen Climbing the Mountain," "Aughra's Observatory," and "The Sky" (which had been created using dispersions in a tank of water).

The original photography for each of these scenes was shot with Eastman Color Negative 5247, and rush-printed onto Eastman Color Print 5383, for examination and approval. The separate elements then had to be combined. Of course we could not simply superimpose these elements, or we would have had ghost images.

First, the foreground, including Batbird, was shot against a blue backing, so that a traveling matte could be made. From the 5247 Color

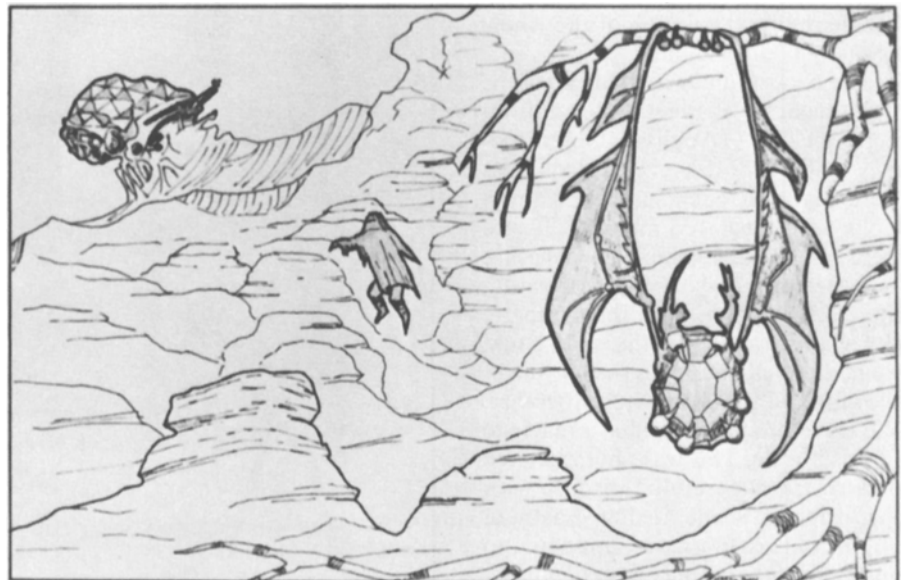


Figure 1. *Dark Crystal*: the art director's diagram.

Presented at the Society's 124th Technical Conference (paper No. 124-59) in New York City on November 10, 1983 by Roy Field, Pinewood Studios, England, and Tony Iles, Kodak Ltd., Hemel Hempstead, England. This revised article was received January 17, 1983. Copyright © 1983 by the Society of Motion Picture and Television Engineers, Inc.

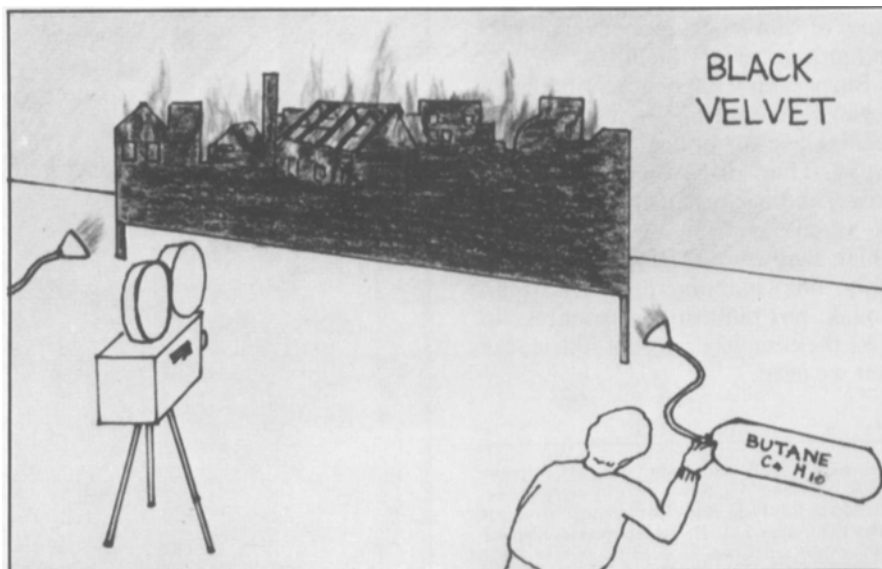


Figure 2. *Gandhi*: the camera used as projector.

Negative, we transferred a print onto Eastman High-Contrast Panchromatic Film 5369. This is called the "matte," and it is used to hold back exposure of the background scene where the image of Batbird is to be printed-in. From this, the "counter matte" is made, again using 5369 film. This is used to mask off the blue background at the "printing-in" stage. The particular shade of blue used is one which can be easily avoided in the picture content, so that a well-defined distinction can be made between the subject and the background.

Three color separations were then made, using blue, red, and green filters, on Eastman Panchromatic Separation Film 5235. This seemingly elaborate method allows precise individual color controls to be made for each of the various picture elements, before the final printing of the whole negative is carried out.

The background was made up of the three separate elements: "Jen Climbing the Cliff," "Aughra's Observatory", and "The Sky." Interpositives were made of each, using Eastman Color Intermediate Film 5243. These were combined, holding back exposure as necessary and using registration mattes. To incorporate the synthetic sky, which was shot in the water tank, we had to delineate it to the outline of the cliff and the observatory together. We therefore hand-painted a matte to fit this profile. This was photographed on a rostrum, carefully lined up with the original scene, using Eastman High Contrast Positive Film 5362, to give a photographic reverse matte. This matte was then used to make the

sky appear behind the outline of the mountain and the observatory.

Finally, all these components were combined on the optical printer, to furnish the composite negative that met the director's requirements.

This apparently uncomplicated scene employed six different grades of film: color negative; high-contrast pan; separation negative; color intermediate; high-contrast print; and color print. In a film like *The Dark Crystal*, it will be obvious to the movie goer that trick photography has been used, although it is hoped that the process will remain invisible.

A Missing Element

In many applications of optical special effects, the audience has no reason to suspect that trick work was

necessary. It may have been employed to meet some demand of cost or practicality. Sometimes, for instance, it is necessary to improvise results, given only minimal material to start with.

One such situation occurred in the recent production, *Gandhi*. On returning to London after location work in India, the director, Richard Attenborough, realized that a particular sequence could be considerably enhanced if an extra scene were made showing Calcutta by night, with small fires burning in a number of places, following a day of riots. All that was available to produce this was a high-angle shot of Calcutta by day that had been shot on Eastman Color Negative 5247. Being a contemporary shot, it also contained some skyscrapers that did not exist in 1947, when the events portrayed were taking place.

A print of the original negative was made on Eastman Color Print Film 5383, which had been specially manufactured with camera negative style perforations. This was then projected onto a 5- x 4-ft sheet of glass, using a standard Mitchell camera as a projector. The projection lighting was provided via a 45° mirror (Fig. 2). The glass had been coated with white emulsion paint, so that the scene could be traced onto it. Next, an artist (in this case, Charles Stoneham) painted in the necessary night sky effects, including a warm glow from the flames. His new sky also covered the unwanted modern skyscrapers. Then, unmodified portions were cleaned off the glass, so that the painted features could later be combined with the modern Calcutta shot.

There was still more to do. In a real

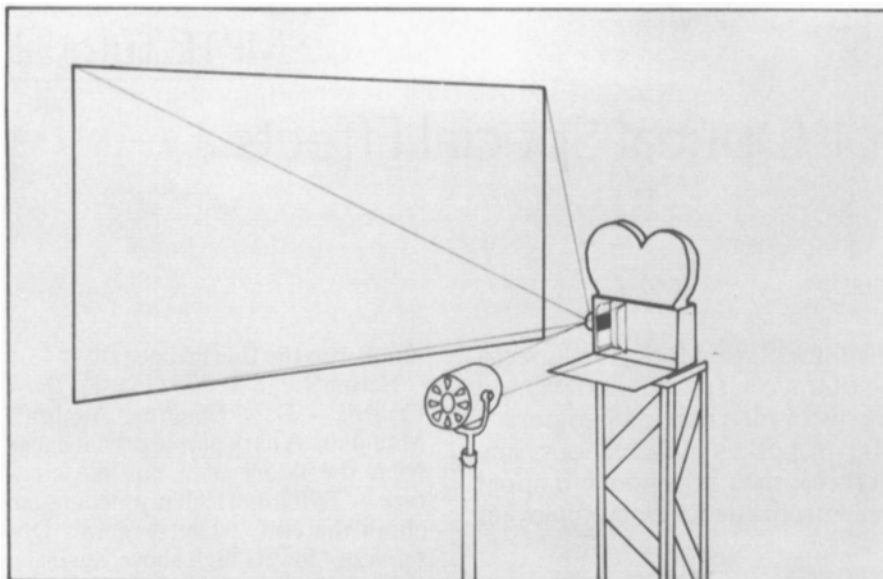


Figure 3. *Gandhi*: photographing the "burning buildings" scene.

night shot, lights would appear in many of the windows. A second glass was made, this time tracing just the outlines of the windows, and cleaning off the paint, so that they could be lit from behind.

Finally, the buildings remained that had to appear on fire. Flames are almost impossible to scale down for model work, so a group of larger-scale silhouettes of the burning buildings were made, each about 5- X 4-ft. They were photographed at 120 frames/sec at a distance of 40 ft, to keep them to the same proportions as the glass shot. The flames were provided by gas jets positioned behind them (Fig. 3).

Now all these separate elements could be brought together. The glass with the night sky was photographed on Eastman Color Negative Film 5247. Black velvet behind the glass ensured that there would be "no exposure" on the cleaned-off portion. Next, the glass was back lit, with a white screen behind it, and was photographed with High Contrast Positive Film 5362. The transparent foreground area became a black matte that was used to block off the unwanted exposure from the original Calcutta scene. This was then successfully printed onto 5369 film, to produce a reverse-matte to hold back exposure in the area which would eventually take the painted sky.

Then, at last, all the separate elements were assembled: the interpositive of the original Calcutta scene, the sky painting, the window lights, the matte, the counter-matte, and the print of the burning buildings. The final composite duplicate negative was then built up. This ostensibly simple scene required the use of five separate film stocks: color negative, for the original photography; color intermediate, for making both interpositive and inter-negative copies; high-contrast positive, for making original mattes; high-contrast panchromatic, for making exactly registering counter-mattes; and color print with negative perforations, for high-accuracy registration copying.

The Quest for Compatibility

In the same film, there was a need to match some old black-and-white newsreel material (shot in the early 1940's on an unknown film stock) with some film that had been specially shot in 1981 on Eastman Plus X Negative 5231. In the course of the story, film from both sources had to be intercut, as part of a contemporary newsreel.

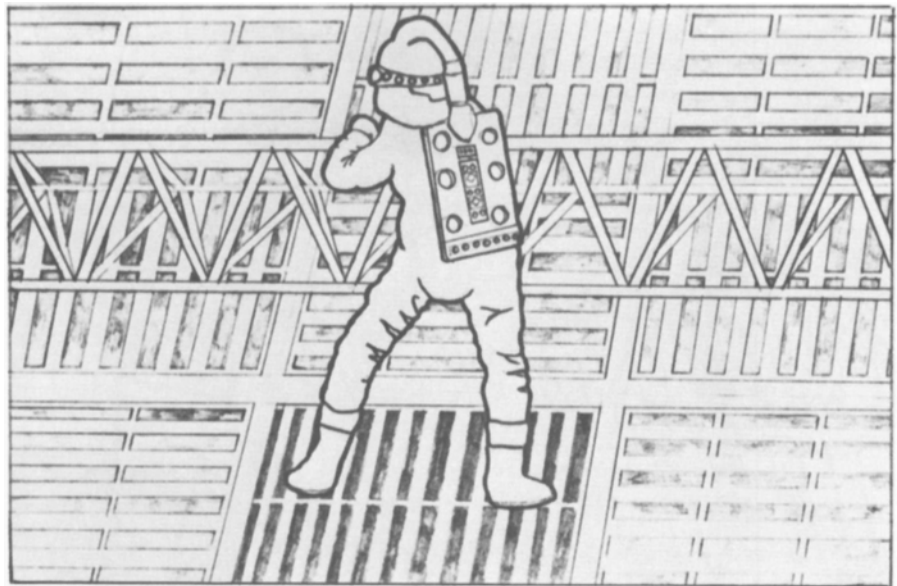


Figure 4. *Outland*: original picture of actor on solar panels.

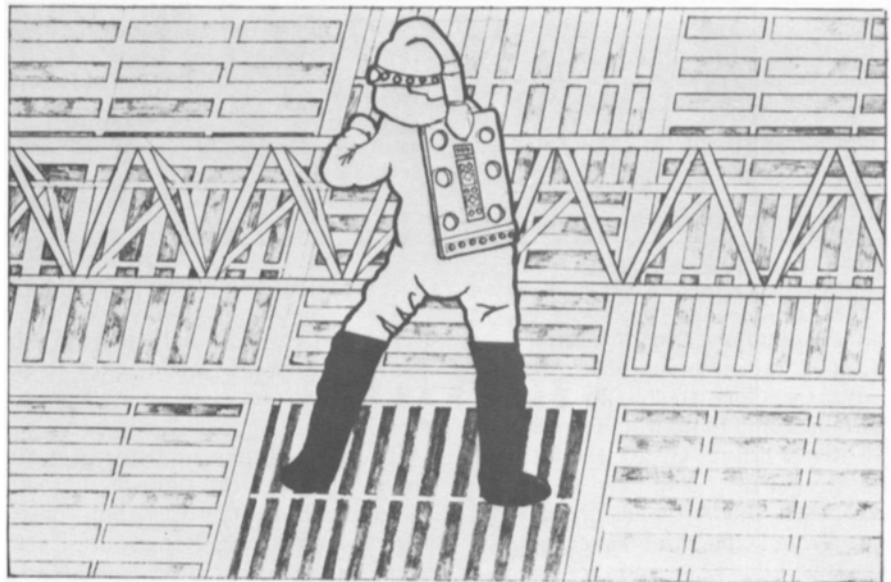


Figure 5. *Outland*: reverse matte of actor's legs.

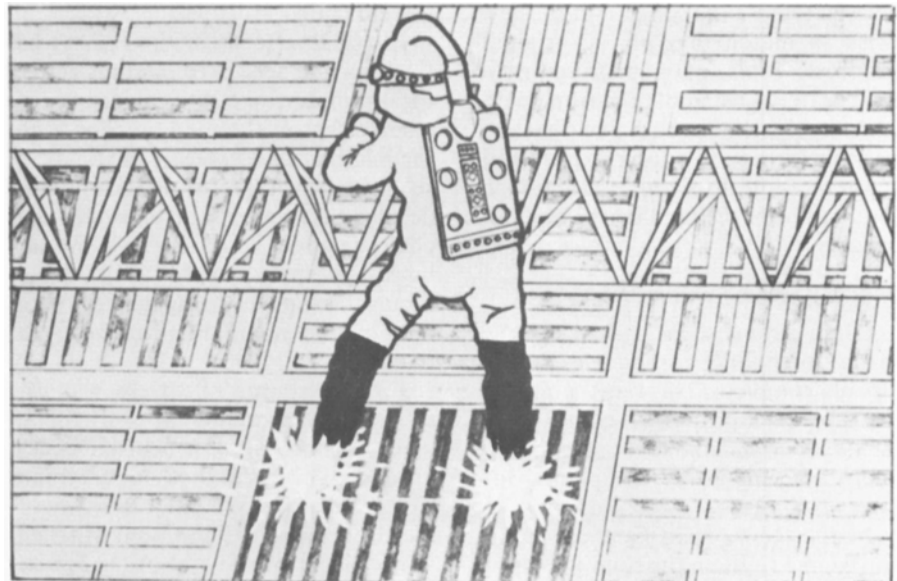


Figure 6. *Outland*: sparks superimposed.

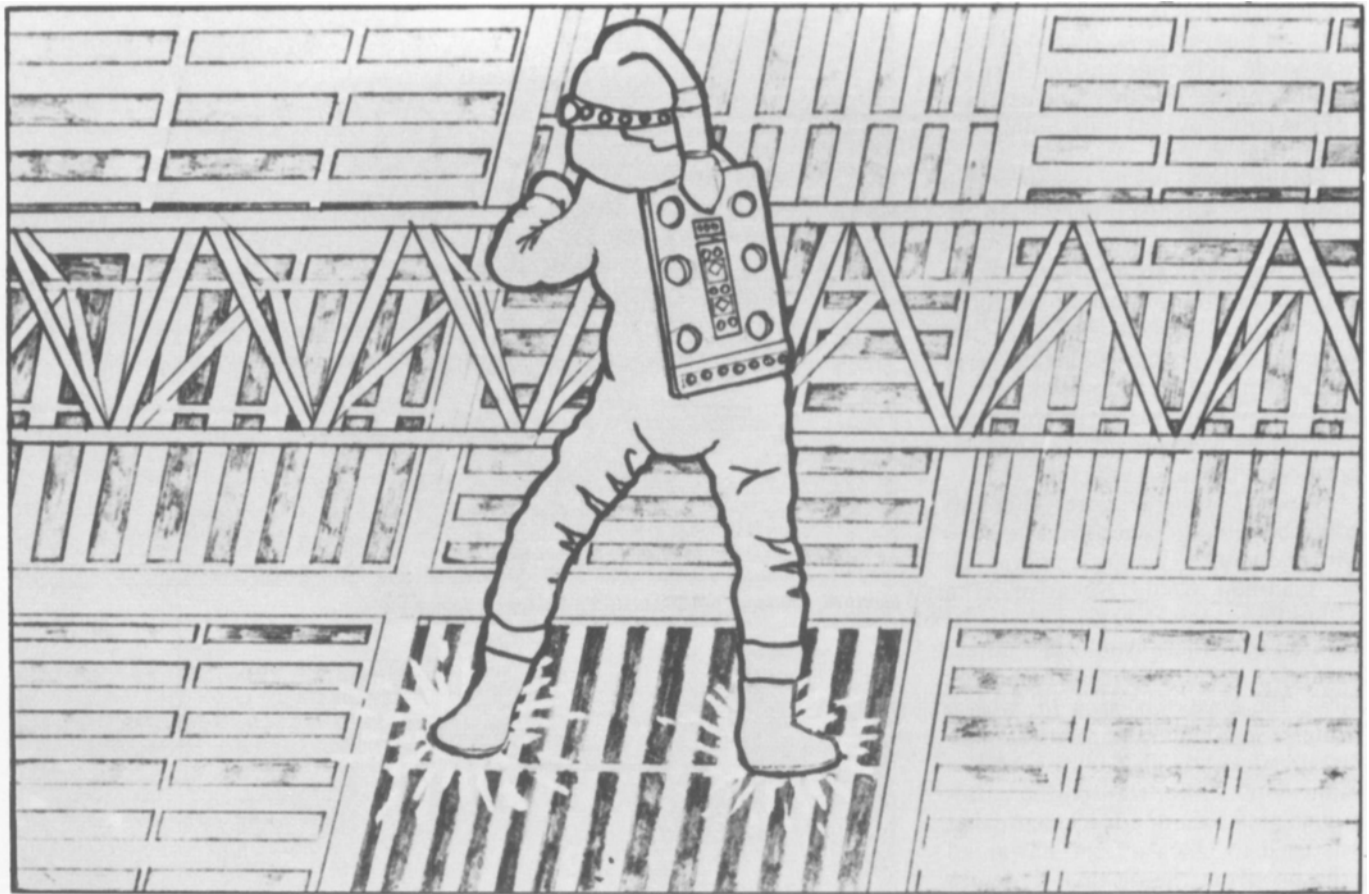


Figure 7. *Outland*: the final effect.

Initially there was a marked difference in appearance between them.

We therefore started by printing both films onto Fine Grain Duplicating Positive Film 5366 to reduce the overall contrast. The new sequences were then further transferred onto Fine Grain Duplicating Panchromatic Negative Film 5234, and then printed back onto Fine Grain Panchromatic Separation Film. This operation was devised to raise the contrast of the new work to match that of the original newsreels. It also gave opportunities to deliberately mishandle the film on an editor's Moviola, in both negative and positive format, to put on sparkle and scratches, and to match the damage that had been suffered by the old material.

Injecting Some Excitement

Often a request for optical work is made, to enhance a sequence that is already complete. This was the case in our next example, which comes from the film *Outland* and takes place on Io, one of the moons of the planet Jupiter.

In the story, Sean Connery is involved in a fight on the solar panels of the space station. This takes place on

a narrow catwalk halfway up the panels, which are about 500 ft in height. Both men are wearing space suits.

The first camera unit had shot all the close-ups of the fight on a small panel section, which was about 35-ft high and 90-ft long. Long shots of the scene incorporated model photography, of course, and some of these also incorporated a special front projection system called "Introvision."

Physical effects of sparking and flashing had been used on some shots, to stimulate an electrical discharge when either of the men touched with the solar panels. On seeing the final cut sequence, the director, Peter Hyams, decided that a great deal of excitement could be added to the scene if similar bursts of sparks could be made to occur, throughout the fight, every time one of the assailants touched the panels.

First, a source of sparks was established — a welder at work on a piece of steel, against a black background. This was shot on Eastman Color Negative 5247 at 120 frames/sec, using an S35 High-Speed Mitchell Panavision camera with various lenses, obtaining images of sparks of a variety

of different sizes to suit the various picture aspects and dramatic circumstances. A close examination of every shot was made to decide the particular moment of occurrence and the position of each flash or burst of sparks in the frame. A registration print of the sequence was then made, on Eastman Print Film 5383 with negative perforations (Fig. 4).

From this, on the rolescope rostrum, appropriate parts of the actors' bodies were hand-traced — legs, hands, helmets, etc. — that appeared to be contacting the solar panel surface on each frame of the sequence. These were then photographed onto Eastman high-contrast positive film, to make a photographic matte. From this a reverse matte was made, using Eastman high contrast pan film, which was used to mask part of the image of the sparks, during printing (Fig. 5).

Then, with the reverse mattes in position, the image of the sparking was superimposed (Fig. 6). However, the effect of the masking was such, that on the final print, the discharges appeared to take place between the actors and the metalwork (Fig. 7).

As a further refinement, the same technique was applied to matte the

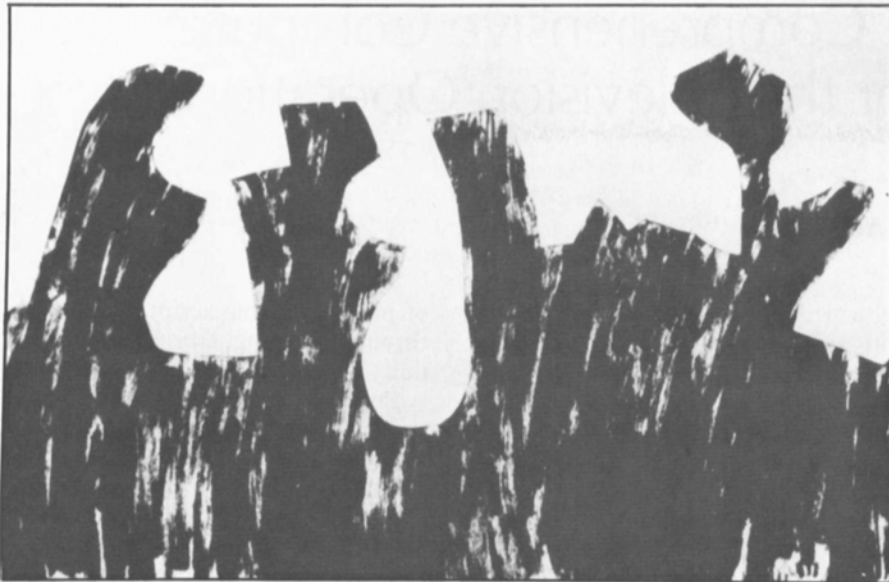


Figure 8. Matte sketchwork, brushwork visible.



Figure 9. Photographic matte, black even exposure.



Figure 10. Photographic counter-matte, outline accurately maintained.

exterior structure of the solar panel grid in certain cases, so the sparks would appear to occur sometimes within the panels themselves, adding depth to the effect.

The properties of the two high-contrast films are crucial to this operation. The High-Contrast Positive Film 5362 can make, from the original matte sketchwork, which may contain variations in texture and density (Fig. 8), an even black exposure in the matte area, against a clear background (Fig. 9).

The High-Contrast Panchromatic Film 5369 has the very exacting task of maintaining the geometry of the outline accurately when the counter matte is made (Fig. 10). This is vital, to eliminate the possibility of fringing, when the two separate picture elements are ultimately combined.

Conclusion

We have outlined some of the current applications for the surprisingly broad range of film stocks that are used in optical special effects work. In their use, there is great dependence, not only on the skills and equipment of the specialist cinematographers, but also on the consistency and quality of the dimensional and photographic properties of the film stock. This, in particular, has allowed the optical effects industry to hold, and improve, its position in theatrical motion pictures, despite the emergence of dramatic alternative technologies.

The manufacturers' ability to produce new and improved film stocks further enhances this situation. For instance, there is the improved Eastman color intermediate film, which further consolidates our work in the vital operation of preparing duplicate negatives, and the new high-speed Eastman Color Negative 5293, which is perhaps the most exciting new development. For years, in all fields of special effects, we have been fighting against the lack of light. Now, at a stroke, we have gained two stops of exposure, with no loss of quality. The gain has been immense.

The symbiosis of optical work and manufacturing developments seems likely to ensure continuing positive support to generations of motion pictures to come.

Bibliography

"Modern Techniques of Optical Trick Cinematography," Roy Field and Tony Iles, *BKSTS Journal*, October 1979.