

## Two New $f/1.9$ Lenses for 16mm and Vidicon Cameras

By G. H. AKLIN

WHEN Eastman Kodak Company announced the 16mm, 100-ft spool camera (the K-100), it also introduced two new  $f/1.9$  Cine Ektar lenses, a 25mm lens and a 50mm lens. These give improved resolution in accordance with requirements of 16mm motion-picture production, and are exceptionally well suited for professional work. The field covered by these lenses is adequate for use with the vidicon tube.

Along with improved resolution, these lenses are matched in spectral transmission so that, in changing from one lens to another, there is no appreciable change in color balance when using color film. They can be fitted to any camera by means of suitable adapters. All air-glass surfaces are, of course, hard-coated and suitable baffling is employed to give maximum image contrast and freedom from flare.

For many years the standard lens on Kodak 16mm Cine Cameras was a 25mm  $f/1.9$  objective of the modified Petzval type. In spite of some shortcomings, this lens was very successful and many thousands were manufactured. In 1948, two

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Cine Ektar lenses of improved construction were announced\*; a 25 mm  $f/1.4$  of the 4-component 7-element meniscus type, and a 4-element 25mm  $f/1.9$  lens, offered as a lower-priced substitute. Both lenses gave much better resolution than the original Petzval type.

Since the introduction of these lenses, the quality of 16mm motion pictures has advanced to the point where a better  $f/1.9$  lens is needed. To meet this requirement, a new 25mm  $f/1.9$  and a new 50mm  $f/1.9$  have been designed. These lenses were introduced when the Kodak K-100, 16mm, 100-ft spool camera was announced.

A sketch of this new 25mm lens (Fig. 1) shows its spherical aberration and field curves. It is of a 4 component meniscus type with 6 elements, in four of which the Kodak high-index glasses are used. The lens is described in U.S. Patent 2,682,198, June 29, 1954. It is designed to cover a 16mm motion-picture frame ( $13.7^\circ$  half angle) and also the photosensitive surface of the vidicon tube ( $16\frac{1}{2}^\circ$  half angle).

Lens bench examination shows that the star images of this lens at full aperture have a diameter of 0.006mm on the axis, and expand to within 0.012mm at the  $14^\circ$  point. At  $16\frac{1}{2}^\circ$  this has reached 0.018mm. The results of a photographic test using a high-contrast resolution chart (1000:1 luminance ratio) at a reduction of 50:1 on three different emulsions are given in Table I. The published resolution values

\* Rudolf Kingslake, "New series of lenses for 16mm Cameras," *Jour. SMPTE*, 52: 509-521, May 1949.

Table I. Resolution Figures of a Photographic Test for the 25mm  $f/1.9$  Using a High Contrast Chart (1000:1 Luminance Ratio) at a Reduction of 50:1 on Three Different Emulsions.

16mm Films	f/	Vidicon				
		Axis $4\frac{1}{2}^\circ$	$9^\circ$	$13\frac{1}{2}^\circ$	$16\frac{1}{2}^\circ$	
Kodachrome Movie Film	1.9	63	50	40	32	25
Daylight Type 5263	8.0	63	50	50	40	25
Eastman Background-X	1.9	63	50	50	32	25
Pan. Negative, Type 7230	8.0	80	63	63	40	25
Eastman Plus-X	1.9	100	80	63	50	32
Reversal, Type 7276	8.0	100	80	80	63	32
Relative Illumination					60%	40%

Table II. Spectral Transmission of Both the 25mm and the 50mm Lenses.

	25mm	50mm
400	78%	68%
450	86	82
500	88	88
550	86	88
600	83	87
700	80	83

Table III. Resolution Figures of a Photographic Test for the 50mm  $f/1.9$  Using a High Contrast Chart (1000:1 Luminance Ratio) at a Reduction of 50:1 on Three Different Emulsions.

16mm Films	f/	Vidicon				
		Axis $2\frac{1}{2}^\circ$	$4\frac{1}{2}^\circ$	$6\frac{1}{2}^\circ$	$8\frac{1}{2}^\circ$	
Kodachrome Movie Film, Daylight Type 5263	1.9	40	40	40	32	25
Eastman Background-X	1.9	40	40	40	40	32
Pan. Negative, Type 7230	8.0	63	63	63	50	40
Eastman Plus-X	1.9	80	63	63	63	40
Reversal, Type 7276	8.0	100	80	80	80	63
Relative Illumination					77%	70%

obtained on the lenses announced in 1948 were made using an emulsion that is no longer manufactured, therefore it would not be practical to make a direct comparison with the new lenses. The relative illuminations at  $13\frac{1}{2}^\circ$  and  $16\frac{1}{2}^\circ$  are also shown in Table I.

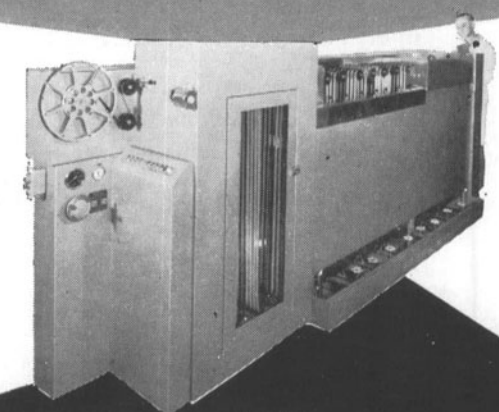
### The 50mm $f/1.9$ Lens

In color photography, the transmission in the blue-violet region between interchangeable lenses on a camera must be closely matched to each lens. It can readily be seen that if this transmission should vary beyond tolerable limits, the color balance would then be noticeably disturbed when changing from one lens to another. One may justifiably assume that a lens having twice the focal length of another lens of the same type would also have twice the glass thickness, and therefore would be expected to show a loss in blue transmission. For this reason the 50mm  $f/1.9$

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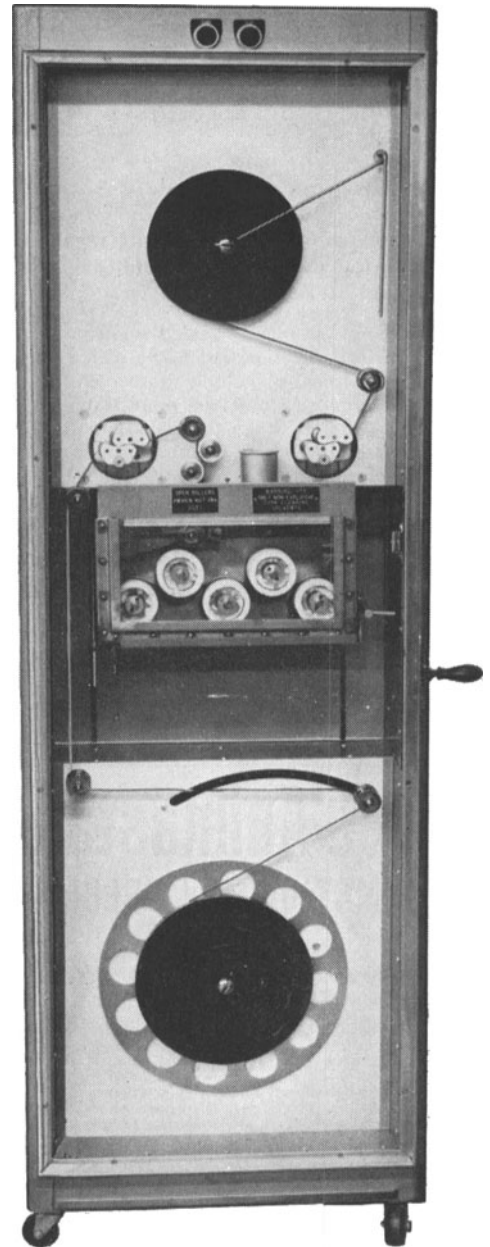
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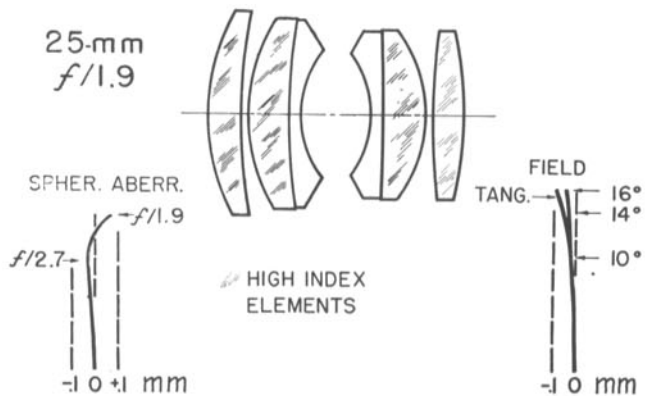


Fig. 1. A sketch of the new 25mm f/1.9 showing the character of its spherical aberration and field curves, and the location of the high index glasses used.

lens could not be merely scaled up from the 25mm formula, but had to be a new design. Requirements include thinner elements and, where permissible, more transparent glasses so that the total absorption would match that of the 25mm formula. Since this lens must cover  $9^\circ$  as against  $16\frac{1}{2}^\circ$  for the 25mm design, certain of these changes are possible and the desired results could be obtained without sacrificing definition. Figure 2 shows this new formula along with its spherical aberration and field curves.

Figure 3 shows the comparable thickness differences between these two lenses, drawn to the same scale.

Table II gives the spectral transmission of both the 25mm and 50mm lenses.

Lens bench examination shows that the star images of this 50mm lens at full aperture have a diameter of 0.015mm on the axis, and increase to about 0.022mm at  $7^\circ$ , and to 0.030mm at  $9^\circ$ . Table III gives resolution figures in a photographic test similar to that for the 25mm f/1.9 lens.

In modern practice, all air-glass surfaces are hard coated, and suitable baffling methods are employed. The result is that a minimum of light is lost in surface reflections and images have maximum contrast free from flare.

Both the 25mm and 50mm lenses are available in S and C mounts. The 25mm lens can be focused from 12 in. to infinity and the 50mm lens from 24 in. to infinity.

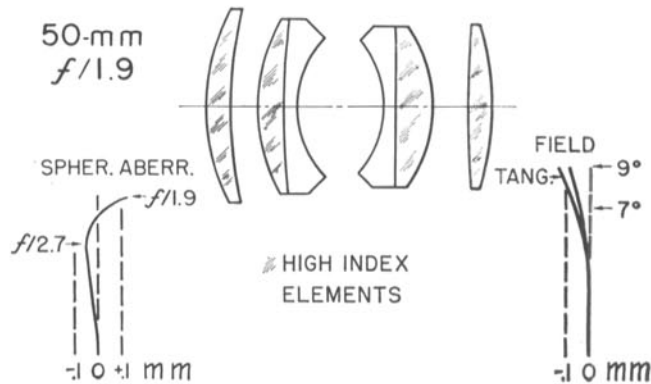


Fig. 2. A sketch of the new 50mm f/1.9 showing the character of its spherical aberration and field curves, and the location of the high index glasses used.

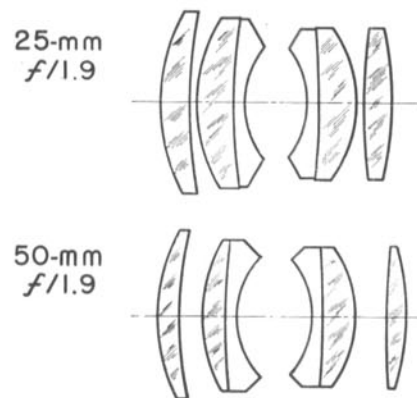


Fig. 3. The comparable glass thickness differences between the 25mm and the 50mm lenses drawn to the same scale.

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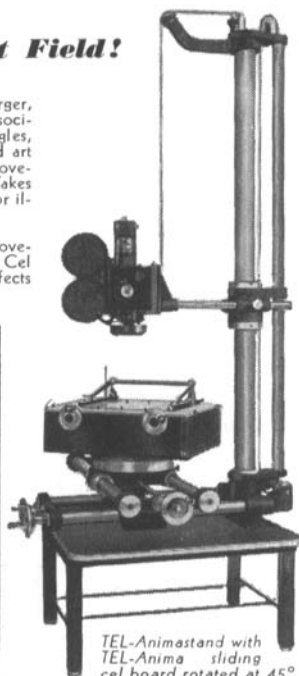
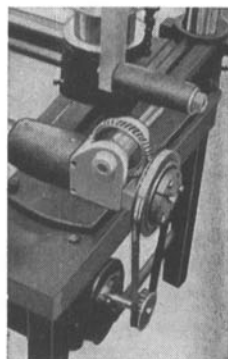
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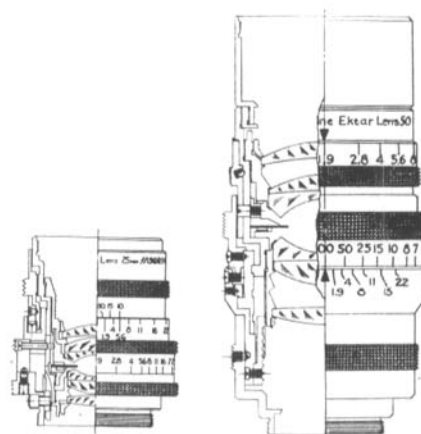


Fig. 4. Quarter section drawings of the 25mm and 50mm lenses in C mounts.

The new-type diaphragm wings are used so that an extended diaphragm scale for the small apertures is obtained, the smallest aperture in both cases being  $f/22$ . All mounts have click stops and depth-of-field scales. Figure 4 shows a quarter section of both the 25mm and 50mm lenses in C mounts.

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