

Discussion and Addendum:

“An Alternative to Super-16” by A. S. King,
 March 1974 *Journal*, pp. 161–162

DISCUSSION

Cary Clayton (Hervic Corp.): It is true that there is existing equipment in a majority of the larger laboratories that makes it feasible to crop and recompose (in a second generation print) an unsqueezed image. However, the existing 16mm film industry is not one that is capable of affording the costs involved in the design, tooling, manufacturing, and marketing of new lens designs and several would be necessary. It is still my opinion that a rather simple and inexpensive aperture modification is the most immediate and acceptable idea for the standardization of the super-16 format.

Mr. King: It is true that the squeezed image could not be televised. But so many anamorphic films have been produced and later broadcast that the technique of producing an unsqueezed, scene-to-scene recomposed print for television is quite common and requires the development of no new technology. Furthermore, my company has done some experimentation in simultaneously composing for aspect ratios of 1.33:1, 1.66:1, and 2.33:1. We find this to be surprisingly easy. It should be possible to scribe a TV safe area on the ground glass and simultaneously compose for TV and wide screen. This would eliminate the need for scene-to-scene recomposition.

ADDENDUM

Let it be pointed out, in the first place, that the author's concept of expressing the total information content of a film frame in bits and the information density in bits/mm² is interesting and undoubtedly very useful. Also his definition of a “Format/Emulsion System” as a system composed of a specified camera format with a calculable frame area and a specified film stock emulsion with a calculable information density is no less useful.

One is, however, also interested in where that information comes from, how it is transmitted to the film by the camera lens, and how the stored information relates to the original subject (or target) information. Information input, information processing, information storage and information retrieval are the principal steps of an information transmission chain. The input is, of course, the information picked up from the subject. Information processing is in part related to the laboratory operations of processing and printing, but also to the optical processing by the taking lens. This takes place before the initial information storing on the film and, hence, must be taken into account before evaluating the amount of information stored.

In the case of a “squeezed” (that is anamorphic) system, as the author calls it, this is particularly important because of the particular way in which the anamorphic system processes optically the available target information. It is thus imperative to consider always a “Format/Emulsion/Objective System” to correctly assess the amount of target information stored.

Information retrieval is, of course, related to projection, where, in case of an anamorphic image, a reverse optical processing step is involved: expansion of the compressed anamorphic image by the projection lens.

After anamorphic compression of the target information by the camera objective with a compression of 2:1, the author's Fig. 1B would be transformed as shown in our Fig. A1.

The effect of this is to exceed the limiting spatial frequency for a 70% response in the horizontal direction (i.e. for vertical lines). For a given percentage response, the limit reproducible spatial target frequency (lines/mm) is only half of what it is in the vertical direction after anamorphic 2:1 compression (see Fig. A2). We find that the frame thus exposed stores a quanti-

ty of target information equal only to what would be on it after exposure through a spherical lens with half the horizontal angular field of view. Only half as many vertical target lines as horizontal target lines can be resolved at a given response level.

It can be seen from the following that the stored target information density in bits/mm² of an anamorphic Format/Emulsion/Objective System with a compression of 2:1 is only half of that of a spherical Format/Emulsion/Objective System with the same focal length, assuming that, ideally, all other optical resolution losses in both systems are equal.

The density of the target information stored on the film is found from the general expression:

$$I = 2V \times 2H = 2^2 \times VH$$

where *I*: stored target information density
V: vertical spatial target frequency at 70% response
H: horizontal spatial target frequency at 70% response
 2: a constant multiplier taking into account lines and spaces
 In spherical optical systems $H = V$, and hence the stored target information for such systems, I_s , follows from:

$$I_s = 2^2 V^2 = (2V)^2$$

In anamorphic optical systems $H = V/2$, and the stored target information density, I_a , is found from:

$$I_a = 2^2 \times V \times V/2 = (2V)^2/2$$

Thus: $I_a = I_s/2$

(Stored target information density for 2:1 anamorphic systems is only half what it is for spherical systems.)

Mr. King's Table II should, therefore, be expanded as shown.

While the anamorphic 2:1 system picks up twice as much target (input) information as the spherical system with equal focal length, only one half of that target information is resolved and stored on the film. Although the absolute total of information bits stored on a given image format area is the same for both systems (because $2 \times \frac{1}{2} = 1$), this total information-bit content nevertheless represents still only one half of the information input of the anamorphic system. In projection (information retrieval), the content is expanded over twice the screen area as is the spherical system image.

The upshot is that the target information that has dropped out as a result of anamorphic compression is not recovered or restored during the retrieval stage of anamorphic expansion in projection, because anamorphic expansion will not restore the information lost initially during information processing by the anamorphic taking lens.

Thus, besides distinguishing between Format/Emulsion Systems and Format/Emulsion/Objective Systems, we must also

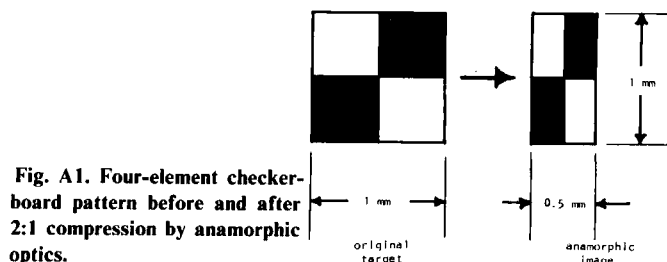


Fig. A1. Four-element checkerboard pattern before and after 2:1 compression by anamorphic optics.

distinguish between absolute information storage capacity in bits of a Format/Emulsion System and target input information actually stored, also in bits, by a Format/Emulsion/Objective System. For an anamorphic 2:1 system, the absolute information content per frame as given by the author should be weighted by dividing by two. — Pablo Weinschenk-Taberner

Table II. Spatial Target Frequencies and Target Information Densities for 70% Response on Modulation Transfer Curves.

Emulsion	Spatial target freq. (lines/mm)		Target info. density (bits/mm ²)
	vertical	horizontal	
<i>Spherical systems</i>			
CNF(54)	17	17	1156
ECN(47)	25	25	2500
EFB	13	13	676
ECO	30.5	30.5	3721
<i>Anamorphic systems</i>			
CNF(54)	17	8.5	578
ECN(47)	25	12.5	1250
EFB	13	6.5	338
ECO	30.5	15.25	1860.5

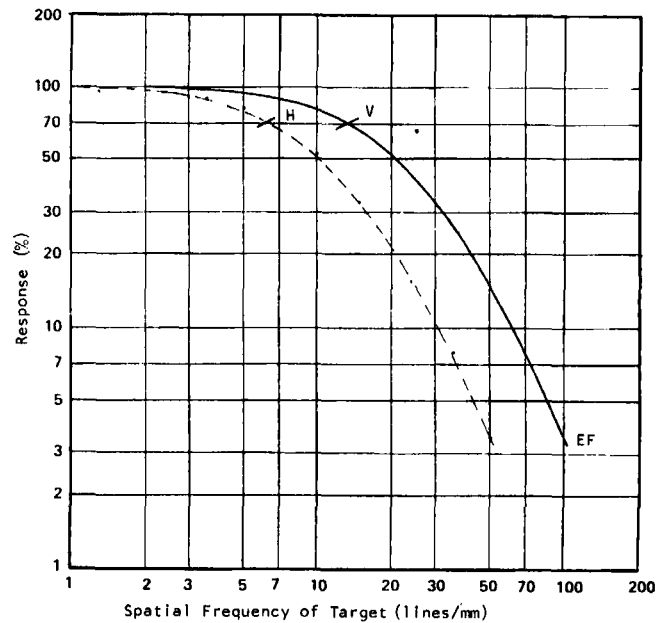


Fig. A2. Horizontal response (H) and vertical response (V) of a spatial frequency test target after processing by anamorphic optics.

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