

Report on the Color Television Study Committee Meeting

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The Ad Hoc Color Television Study Committee of the JCIC met in New York City on November 20, 1968, and its Task Force on Signal Standards conducted a field test in Chicago on December 18 and 19, 1968. The principal items on the agenda for the meeting on November 20th were consideration on the first reports of the Task Forces appointed at the preceding meeting of the Committee, and discussion of the plans for the field test in Chicago.

E. P. Bertero, Chairman of the Task Force on the Colorimetry of Television Camera Systems, reported that the major problem was that of reproducibility and uniformity of the characteristics of camera systems. This problem could be brought under control by the establishment of colorimetric tolerances on the colors produced on a *standard* color monitor driven by the camera system under test when the camera was picking up reference standard colors. It was brought out in discussion that there had been several attempts in the past to design a suitable test chart embodying reference standard colors. Each of these attempts had been abandoned because of uncontrolled fading of dyes when exposed to the radiation from an illuminator. As a further indication of the need for testing camera systems with non-achromatic colors, Chairman K. Blair Benson reported that with camera systems aligned for good color reproduction, the USA and CBC networks were all in agreement on the input-output characteristics as measured with gray scales. Despite this agreement, there were marked differences of skin tones from the three USA networks when viewed on a single receiver. It was agreed that the Chairman of the Ad Hoc Committee should refer the problem of the measurement and the specification of the colorimetric performance of camera systems to the Engineering Committee on Television of the SMPTE.

Related to the report of the Task Force on the Colorimetry of Television Camera System, Gideon Fiat, an alternate representative of NAB, mentioned that he was Chairman of a Task Group on Color in Relation to TV, which had been formed in US National Committee E-3.1.9.2 on Photography, TV and Stage Lighting, of the Commission Internationale de l'Eclairage (CIE). The charge to this Task Group is the collection of information and the recommendation of programs leading to better understanding and ultimately to standardization of various aspects of color in relation to TV. As a first step in meeting its charge, this Task Group is preparing a general test to review the psychophysical problems of viewing color television. Fiat suggested that the work of the CIE Task Group may be of great value to the JCIC Ad Hoc Committee for the Study of Color Television.

C. E. Anderson, Chairman of the Task Force on Video Tape Recording, reported a study of the effects on variations of synchronizing signal and chrominance burst timings and waveforms at the input to a video-tape recorder, on the signal as reproduced. Varying burst amplitude at the input to a recorder is reproduced as constant burst amplitude; but the variations of the input burst amplitude are transferred to the amplitude of the chrominance signal. Many correction circuits in recorders utilize the duration of the burst in their operation, so that variations of burst duration can affect the reproduction of color. Incorrect timing of the burst with respect to the horizontal sync pulse also can affect the reproduction of color. Tests to obtain quantitative data on these effects will be performed by the Engineering Committee on Video-Tape Recording of the SMPTE.

D. M. Zwick, Chairman of the Task Force on Motion-Picture Films, reported the results of subjective observations and objective measurements on more than 200 16mm and 35mm motion-picture films which had been used for broadcasting. These films included program material, news shots, and commercials. In brief, the 35mm films varied less in color than did the 16mm films; and program and news material varied less than did the commercials. With respect to the commercials, it was concluded that of 180 samples in all, there were 30 that would not look good to any observer, whether viewed by television or by direct projection. The picture quality of another 40 films would be considered questionable by most observers. Zwick mentioned that people tolerate quite large distortions of color as long as the character of the distortion remains constant. People are far less tolerant when the character of color distortion varies. This, of course, is the situation in broadcasting where a program film may be followed by several commercials in rapid succession. This whole problem has been referred to the Engineering Committees on Color and on Television of the SMPTE for their study.

N. R. Grover, Observer from the CBC, advised the Committee that problems of prime concern to the the CBC were standardization of monitors, camera systems, viewing conditions, test signals for in-use checking, color test films (not to be confused with the color reference films available from the SMPTE), subjective quality-grading systems, and the apportionment of overall tolerances among the portions of a television broadcasting system. It was agreed that the Chairman of the Ad Hoc Committee refer the problem of the in-use test signals (vertical interval test signals — VITS) to the Groups on Broadcasting and on Broadcast & Television Receivers of the IEEE.

W. C. Morrison, a representative of the IEEE Group on Broadcasting, offered the recommendation that a test be started, similar to the one made by John H. DeWitt, Jr., in Nashville, Tenn., except that the test be made under normal operating conditions, and over an extended period. DeWitt reported his experiment in a paper "Color Uniformity in Multi-Station Markets" before the IEEE Fall Broadcast Symposium in Washington, D.C., on September 20, 1968. At a single receiving location, color-bar signals were observed on a vectorscope and differential phase was measured on staircase plus sine wave signals. The test signals were generated at one point and broadcast simultaneously from the three stations in the Nashville area. When the observed phase differences between stations were minimized by readjustment of each transmitter, there was a marked reduction of the variation of color observed when a receiver was tuned from transmitter to transmitter. Morrison's recommendation was tabled for consideration at a later meeting of the Committee.

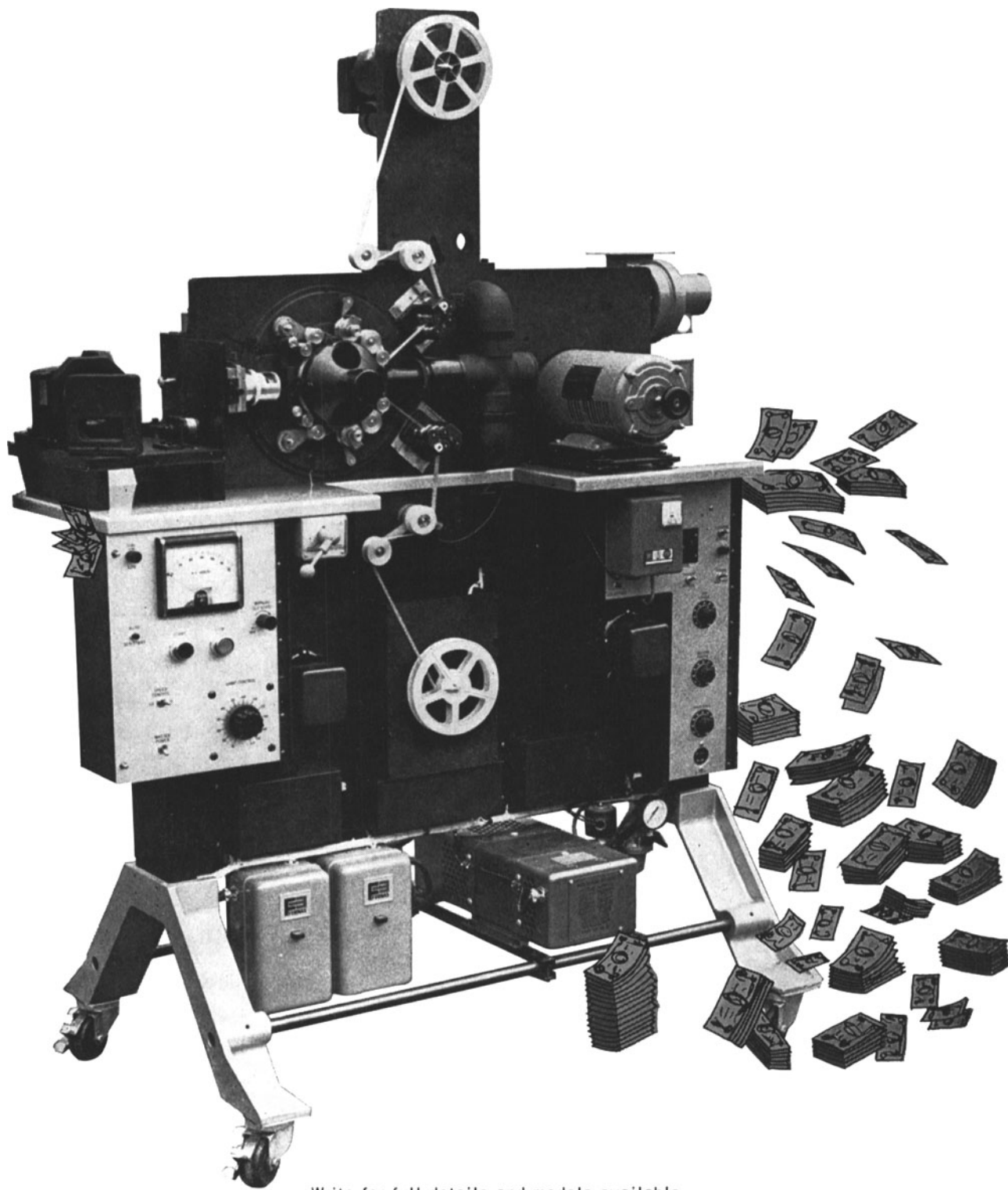
B. D. Loughlin, Chairman of the Task Force on Signal Standards, reported in detail on the plans for the field test to be held in Chicago on December 18 and 19, 1968. These tests have been performed, and the highlights of the observations are described below.

The purpose of the Chicago field test was the subjective evaluation of the effect on pictures reproduced on typical receivers when each of the parameters of the broadcast color-signal waveform was varied within the limits permitted under the FCC Rules. The test was divided into two parts. In the first part, a laboratory-type transmitter was used, which allowed for controlled variation of each of the parameters of the

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signal waveform. In the second part of the test, signals generated at a common point were received from the local transmitters of the three major USA networks. Preceding the tests, the transmitters were checked by the station personnel.

Four receivers, each from a different manufacturer, were used. These were "top of the line" models, equipped with automatic chrominance control and either injection or phase-locked chrominance oscillator circuitry. Prior to the tests, each of the receivers was aligned to meet the performance specifications of its manufacturer. For each test, each receiver was adjusted by a representative of the receiver manufacturer.

In the laboratory part of the test, five slides were used in a flying-spot scanner to generate the pictures which were viewed on each of the receivers in turn. A-B comparisons were made for values of the waveform parameters taken in pairs. The changes of color between the two conditions of a pair were evaluated on a six step subjective rating scale, for which the ratings ranged from "Imperceptible" to "Unusable." There were 16 pairs of conditions in this test, six where the amplitude, the duration, or the position of the burst was varied, two where the relation between black level and blanking level was varied, and eight where the amplitude and the phase of the chrominance signals were varied.

Variation of the amplitude, of the duration, and of the position of the burst, taken singly or in combinations, produced changes which, when the ratings were averaged over all observers and over all receivers, were only marginally worse than "Just Perceptible." However, two of the receivers were more susceptible than the other two to reduction of the burst duration to the minimum value permitted under the FCC Rules. When this condition existed in an A-B pair, the ratings of the color changes on these receivers ranged between "Definitely Perceptible but not Objectionable" and "Somewhat Objectionable."

Variation of the setup (difference between black level and blanking level) between its normal value and either of the limits specified in the FCC Rules, resulted in color changes which were evaluated as falling in the range between "Just Perceptible" and "Somewhat Objectionable." The average over all receivers and all observers fell close to "Definitely Perceptible but not Objectionable."

Variation of either the phase alone or of the amplitude alone of the chrominance signal from its normal value to the limits permitted under the FCC Rules produced color changes which were judged to be slightly smaller than those produced by changes of setup. However, the average ratings of the changes of color resulting from variation of both the amplitude and the phase of the chrominance signal from one limit

to the other limit, or variation of the amplitudes of both the I and the Q signals over the extreme permitted range, were in the range from "Somewhat Objectionable" to "Definitely Objectionable."

In the off-the-air part of the test, the receivers were adjusted for the best picture from one transmitter, and the change of color was evaluated when the receiver was tuned to a second transmitter. The change of color between the first and the third transmitter was then evaluated. This whole procedure was repeated with the receivers adjusted for the best picture from the second transmitter; and repeated again with the receivers adjusted for the best picture from the third transmitter. There were no marked differences between the color changes observed in any of these A-B comparisons. The color difference was evaluated as "Definitely Perceptible but not Objectionable" when the results of all of the comparisons were averaged over all observers and over all receivers.

Some significant points which have been gleaned from an analysis of the field-test data are as follows:

(a) The laboratory tests generally confirmed the work of those who originally determined the allowable tolerances in the signal specifications. A possible exception resulted from simultaneously combining the permissible signal variations affecting hue and saturation. The test data will be turned over to the EIA Broadcast Television System (BTS) Committee for further investigation and for possible recommendations for revisions of the signal specifications.

(b) Receivers may be affected by burst timing, duration, and amplitude. Variations between receivers utilizing different circuit designs reflected the different tradeoffs made by the several manufacturers. This problem will be referred to the EIA Receiver Committee and to the IEEE Broadcast and Television Receiver Group for consideration of the design problems, and to the EIA BTS Committee for consideration of the need for revised standards.

(c) The tests which included transmitters and propagation paths showed definite variations of color. Additional tests are planned to help locate the cause of these variations.

The CCIR, EBU and SMPTE are actively studying film transmission and plan to propose Recommended Practices for greater color uniformity, as well as higher quality.

It is apparent that the disturbing lack of uniformity among color television pictures is being attacked from many angles. Most encouraging is the enthusiasm and energy of those engaged in this study. Thus, although the task is a difficult one, embracing all phases of television, broadcasting and reception, significant progress is to be expected.