

Measurement techniques and operational adjustments of broadcast VTRs —

**Part 1: Guide to operational
adjustments on analogue composite
broadcast VTRs**

Committees responsible for this British Standard

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- Association of Professional Recording Services Ltd.
- Audio Engineering Society
- British Broadcasting Corporation
- British Kinematograph, Sound and Television Society
- British Tape Industry Association
- Independent Broadcasting Authority
- Independent Television Association
- National Council for Educational Technology (NCET)
- Royal Photographic Society
- Royal Television Society
- Sound and Communication Industries Federation

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National foreword

This Part of BS 7537 has been prepared under the direction of the Electronic Equipment Standards Policy Committee and is identical with IEC 1055-1:1991 “*Measurement techniques and operational adjustments of broadcast VTRs — Part 1: Operational adjustments on analogue composite broadcast VTRs*”, published by the International Electrotechnical Commission (IEC).

This British Standard describes the operational alignment procedures which are peculiar to the types of VTRs used in television production and which are recommended for adoption within the European Broadcasting Union (EBU). It is important for these machines to be aligned according to clearly defined criteria so that recorded tapes will conform to the standards and to avoid compatibility problems during international programme exchanges. These recommendations were based on the results of investigations conducted by EBU Sub-group G2 (Television tape recording) and were published by the EBU in document Tech. 3219-2 “Operational alignment procedures”.

Section 1, concerning transverse track VTRs, comprises the corresponding passages of EBU document Tech. 3219 (1976) suitably updated.

Sections 2 and 3 are concerned with B format and C format VTRs using 25.4 mm tape.

Section 4 is concerned with U-matic H format using 19 mm tape. This type of format is not recommended for international exchanges, but it is in widespread use for ENG.

NOTE *Typographical error.* In 1.2.4, the first paragraph following Figure 2, the second word “cntrols” should be read as “controls”.

Copies of EBU documents may be purchased from the Technical Centre of the European Broadcasting Union, Cas Postale 67, CH-1218 Grand-Saconnex, Geneva, Switzerland. Telephone + 4122 717 2111 Telefax + 4122 798 5897.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 16, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

Section 0. General

0.1 Scope

This technical report defines operational adjustments on analogue composite broadcast VTRs.

Section 1. Operational alignment of transverse-track VTRs

1.1 EBU alignment tape

The purpose of the alignment tape is to make the checking of the machine as easy as possible and, to this end, a split picture was chosen so that a multiple check could be made on picture and waveform monitor displays.

The waveforms of the signals before recording are depicted in Figure 1. The upper half of the picture consists of the CCIR insertion signal, as specified for line 330, repeated on each line: luminance bar, 2T sine-squared pulse and 5-riser luminance staircase with superimposed sub-carrier. The lower half of the picture consists of a 100/0/75/0 colour-bar signal¹⁾.

The sound track carries alternating French and English announcements interrupted by 1 000 Hz tone at the reference level of 100 nWb/m r.m.s. There is no recording on the cue track.

The tape used is Scotch 400 with average characteristics. It is supplied in rather long sections and it is anticipated that broadcasting organizations will cut them into short pieces for alignment purposes and will perhaps splice short lengths of their normal video tape stock onto these (see clause 1.3).

The complete EBU specifications of the alignment tape for transverse track VTRs appear in EBU document Tech. 3084 [1]²⁾.

Alignment tapes have a limited operational life and shall be handled with extreme care if they are to provide faithful alignment of VTRs for long periods. Guidance on their use and storage will be found in Annex A. Strict adherence to the manufacturers' handling procedures is essential.

1.2 Alignment of the playback chain

The objective in using the alignment tape is to adjust the machine so that it will give optimum reproduction of a first-generation verified recording. The process involves playing back the alignment tape while making the necessary adjustments and then making trial recordings and adjusting the recording conditions until the quality of reproduction of these recordings is similar to the quality obtained from the alignment tape.

It is assumed that the spacing between the video head and the control-track head has already been checked and that the video heads are co-planar, in quadrature and have similar tip projections.

The order of alignment checks is as follows:

- a) video head/control-track phase;
- b) relative positions of headwheel and vacuum guide,
- c) video level;
- d) video linearity — i.e. equalization of playback channels, differential phase and gain performance, record drive conditions;
- e) audio level.

1.2.1 Control-track phase

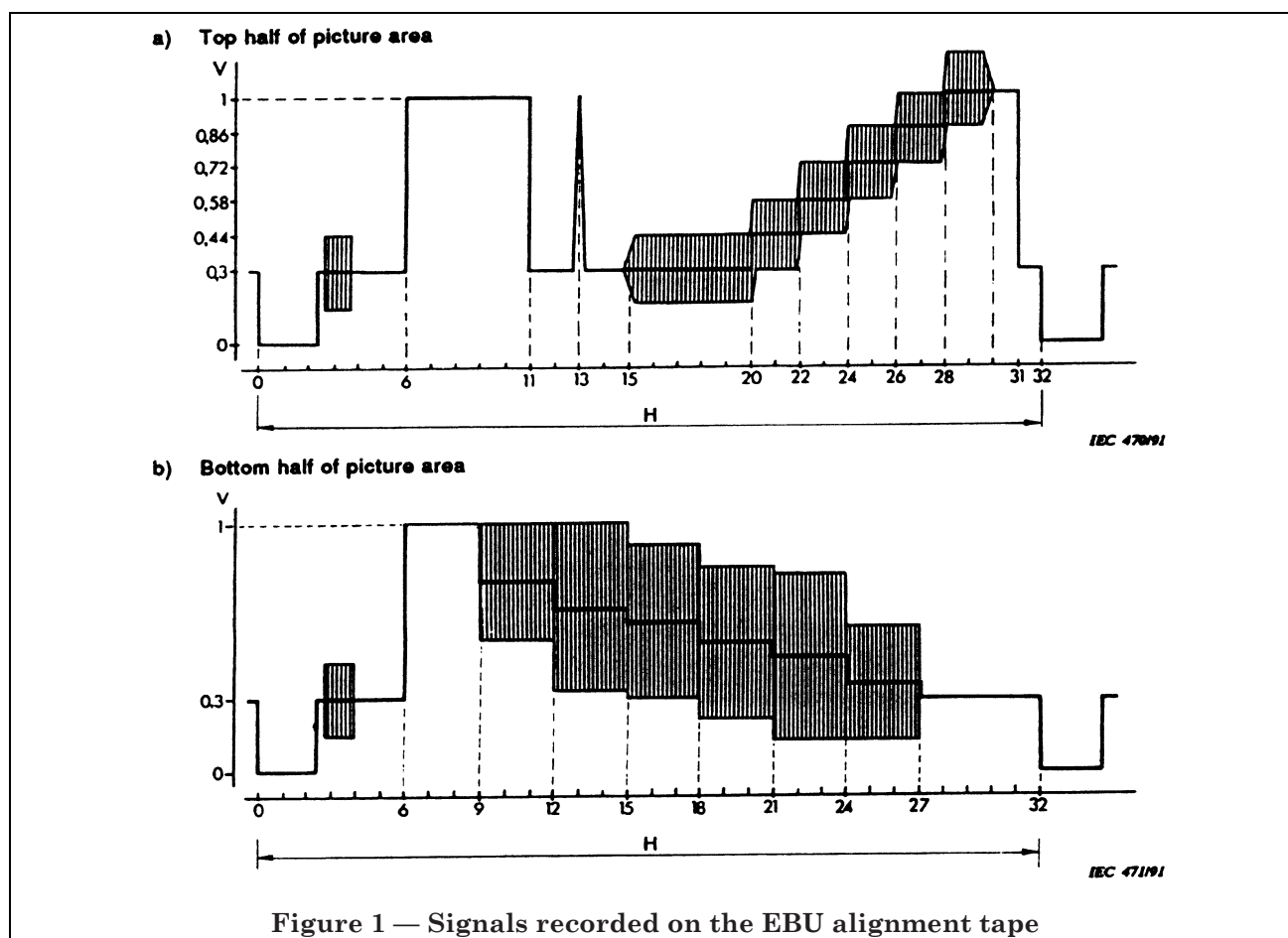
On machines that allow adjustment of the tracking, it is normal to set the control-track phase potentiometer to the point that gives maximum FM output on the oscilloscope display. At this time it is convenient to make a visual check of the stability of the capstan servo and the headwheel servo.

The beginning of a fault condition or misalignment in the capstan servo is indicated by oscillations in the amplitude of the FM output display. (On some machines, small oscillations of the FM amplitude are always present.) The beginning of a fault condition in the headwheel servo can also be visually checked at this time by observing the amplitude of the jitter of the tachometer dots on the raster when the picture monitor is locked to a stable external reference. (A limited amount of jitter is always present.) Jitter can be caused by servo malfunction or by tape problems such as incorrect slitting.

At the same time, the position of the headwheel tachometer dots should be examined on a video monitor displaying the demodulator output and operated in the pulse cross mode.

¹⁾ United Kingdom users have a 100/0/100/0 colour-bar signal.

²⁾ The figures in square brackets refer to the bibliography, Annex B, page 16.



The position of the dots on the picture, when playing the alignment tape, depends on the individual machine and on the individual headwheel. It is theoretically possible to standardize the position of the dots on the picture by adjusting the electronic timing of the machine dot generator and aligning the mechanical position of the tachometer pick-up head on the headwheel panel. The recommended approach, however, is to mark the actual position of the tachometer dots on the picture monitor when playing the alignment tape, and then to apply the procedure described in 1.3.2.

1.2.2 Relative positions of the headwheel and vacuum guide

If, on replay, any of the geometrical factors are incorrect, it will not be possible to reproduce the precise relationship between the video heads and the tape that existed during the recording of the alignment tape. The most common errors are quadrature, skew and scallop. These take the form of timebase errors and they are caused by incorrect positioning of the video heads.

At this stage, the relative positions of the headwheel and the vacuum guide should be adjusted using the procedure described in 1.4.1. This procedure serves to minimize the amplitude of the timebase-error signal generated by the monochrome timebase corrector.

It should be mentioned here that it is quite common for the guide height to be adjusted to give maximum flatness of the oscilloscope display of the FM amplitude. If the machine is being aligned to play a particular tape and this method produces the most acceptable pictures when playing that tape, then obviously discretion is used in adopting a compromise. However, the timebase-error method is the most sensitive and should be used to align the machine for optimum recordings.

The guide height and position should preferably not be changed until the next complete alignment. (This is feasible on machines equipped with velocity compensators.)

1.2.3 Video level adjustment

Following calibration of the oscilloscope, the alignment tape is replayed and adjustments are made, if necessary, to obtain standard levels at the output of the machine and at other monitoring points in the playback chain. At the same time, the peak-white signal, available on many machines for deviation checks, should be compared with the off-tape signal. Any discrepancy indicates a fault condition.

1.2.4 Video linearity and equalization

The split picture signal recorded on the alignment tape was specially chosen for its usefulness in carrying out these adjustments. An oscilloscope field-rate display of the demodulator output, showing the sub-carrier superimposed on the staircase, allows the simplest adjustment of the individual channel equalizers for identical outputs (Figure 2). The colour-bar signal enables the differential gain and phase to be critically adjusted by examination of the oscilloscope field-rate display and the vectorscope display. Although this is the recommended procedure, other approaches can be employed. For example, a line-rate display, via a 4.43 MHz band-pass filter, of the sub-carrier superimposed on the staircase permits examination of the differential gain although small differences are usually masked by noise. The colour-bar waveform could be used to set the equalizers but, because of the more complex waveform of the colour bars, it is easier to make the adjustments using the sub-carrier superimposed on the staircase. Once the equalizer settings have been determined, however, small linearity differences are more noticeable on the colour-bar waveform.

The controls provided for making these adjustments depend on the type of machine and their effect varies according to the circuitry used by the different manufacturers. The following general method will be applicable to a wide variety of machines, but it is advisable to consult local instructions or manuals.

- The reactive and resistive controls (known as F and Q or X and R or C and Q , depending on the type of machine) are used to compensate for the head-resonance characteristics. The initial settings can often be found by means of a probe placed close to each video head in turn. When this is possible, the reactive and resistive controls are set for each head to give a flat response followed by a smooth roll-off as seen on an oscilloscope display of a frequency-sweep test signal. This procedure, when available on a machine, precedes the lacing of the tape.

- The overall equalization control is set to give the most level response from all the channels when the alignment tape is played.

- The individual head-equalizer controls are used to match the outputs of each head. Head No. 1 is normally taken as the reference. These adjustments are made with the automatic chrominance circuits switched off while the demodulator output is being examined. If the individual heads cannot be matched, it will be necessary to re-adjust the master equalizer. Once the equalizer settings seem to be nominally correct, fine adjustments are made to the reactive controls to improve the differential parameters of each head. (Some machines have a differential gain control for this purpose.) The adjustments must be repeated several times to achieve optimum performance. The automatic chrominance circuits are then switched on and appropriate adjustments are made to ensure that the system is operating in the centre of its correcting range. Once again, further fine-trimming adjustments are necessary if the colour monitor displaying the machine output exhibits banding or small variations of the colour saturation on a line-by-line basis, for PAL signals (*hanover bars*).

After this the following checks should be made:

- the 2T pulse transient response is examined (expanded line-rate oscilloscope display);
- the 2T pulse-to-bar ratio indicates errors in the mid-frequency response;
- the bar tilt reveals errors in the low- to mid-frequency response;
- if excessive moiré is visible, the demodulator balance and symmetry controls, if available, should be adjusted for minimum disturbance on the colour monitor or the smallest colour-bar dot size on the vectorscope;
- noise is examined using a vectorscope or a waveform monitor;
- the operation of automatic chrominance circuits, velocity-error corrector, monochrome and colour timebase corrector, and drop-out compensator should be checked.

As a guide it can be said that a quadruplex video tape recorder reproducing the alignment tape should give a differential gain of 4 % or less, and that the gain and phase errors due to moiré, noise and differential effects should result in the colour-bar dots occupying most of the 5° boxes on the vectorscope graticule. Velocity errors will produce a jitter which will be more apparent the further in time a colour occurs after the colour burst. The blue bar is usually the most affected.