# SMPTE RECOMMENDED PRACTICE

**RP 35-1990**

## Specifications for Theater Test Film for 35-mm Photographic Monaural Motion-Picture Projection Audio Reproducing Systems



1. *Scope*

This practice describes a test film for subjective evaluation and adjustment of 35-mm photographic monaural motion-picture projectors and audio reproducers and for judging the acoustical environment of the auditorium or room in which the audio is reproduced.

2. *Test Film*

2.1 The test film shall contain an audio record and accompanying picture for sound identification only which are samples selected from studio feature pictures by an appropriate Engineering Committee of the Society of Motion Picture and Television Engineers. The following samples are typical of those which may be included:

(1) Main title music
(2) Dialogue
(3) Piano
(4) Orchestral music
(5) Vocal music
(6) Sweep frequency tones
(7) A short cross-modulation section

The material is intended to provide a subjective evaluation of such reproducing system characteristics as:

(1) General frequency response
(2) Volume range
(3) System noise
(4) Power-handling capacity
(5) Wow and flutter
(6) Distortion and vibration

2.2 Each film shall be provided with head and tail leaders, as specified in American National Standard for Motion-Picture Film — Leaders and Cue Marks — 35- and 16-mm Audio Release Prints, ANSI PH22.55-1983.

2.3 The main title shall include the issue number of the film so that revised versions may be easily identified.

2.4 The test film shall be made available in 35-mm format. The length of the film shall be approximately 400 ft.

3. *Related Standards*

3.1 Audio Record. The audio record shall comply with American National Standard for Motion-Picture Film (35-mm) — Photographic Audio Records — Release Prints, ANSI PH22.40-1984.

3.2 Projectable Image. The accompanying picture shall comply with American National Standard for Motion-Picture Film (35-mm) — Projectable Image Area — Motion-Picture Prints, ANSI PH22.195-1984.

3.3 Motion-Picture Film Stock. The prints shall be made on color stock, preferably polyester, splice free, of the low-shrinkage, safety type in accordance with American National Standard for Motion-Picture Film — Safety Film, ANSI/SMPTE 223M-1985, and cut and perforated in accordance with long-pitch dimensions specified in American National Standard for Motion-Picture Film (35-mm) — Perforated KS, ANSI/SMPTE 139-1986.

3.4 Photographic Audio. The photographic audio negative shall include a 9-kHz section of cross-modulation test, as specified in SMPTE Recommended Practice on Cross-Modulation Tests for Variable-Area Photographic Audio Tracks, RP 104-1987, and the prints from this negative shall be measured to read percent cross-modulation distortion. Image spread on the prints should not present more than 2 percent cross-modulation distortion.

NOTE: A test film made in accordance with this practice is available from the Society of Motion Picture and Television Engineers.



Revision of RP 35-1985
Approved April 24, 1990



## Appendix

(This Appendix is not part of the SMPTE Recommended Practice, but is included for information only.)

From a typical location in the room or auditorium where the audio is reproduced, the observer should determine whether or not the sound characteristics of the complete reproducing system are acceptable by listening to the audio reproduced from the test film when the volume control is set to reproduce the dialogue at normal level.

If the picture and audio quality are displeasing and the dialogue unintelligible, then either (a) the equipment should be adjusted as shown in the technical manual provided by the manufacturer or (b) the room in which the audio is reproduced is unsuitable. Methods by which these factors may be determined should be included in the instruction sheet.

# SMPTE RECOMMENDED PRACTICE RP 56-1990

## Safe Action and Safe Title Areas for 8-mm Release Prints



*Introduction*

Early in the development of the 8-mm type S program, it was recognized that the format would be used both for direct front and rear projection systems. Some committee members were concerned that the usable projectable image area might be different without specific standards for the two systems. It was, therefore, decided that it would benefit producers and laboratories if safe areas were developed for the 8-mm type S and 8-mm type R formats. This concept became more important as the image area documents changed from the concept of specifically defined areas with tolerances for size and positioning to the internationally agreed to system of developing a minimum camera area and a maximum projectable image area.

When the minimum and maximum area concept was accepted, the restatement of the positioning tolerances for the width caused a slight change such that the precise ideal format of 4:3 was lost in most cases. However, during the development of the initial committee document, it was recognized that there may be future application of the 8-mm type S system in television. Therefore, the need to maintain a precise 4:3 format for telecine use is significant. To derive the most useful areas, the committee proposes to utilize the standardized maximum projectable image area height for each format as the basis for all measurements.

For clarity and ease of understanding, a value of 100 percent for both the height and width has been established as shown in the figure. Because an ideal format does not exist, the 100 percent image area height is established as the basic parameter and the 100 percent width is derived by a ratio multiplication of 4:3 times the height. All other values shown in the table are percentage ratios with the exception of those in the last column, which are derived from the related American National Standards (see Section 3.4). By applying the above principle, the document achieves maximum usefulness while losing only 2 percent of the standardized width which can, when needed, be available for direct projection application.

1. *Scope*

1.1 This practice specifies the dimensions of the nominal safe action and safe title image areas for 8-mm release prints. The information provided applies to the use of these prints by either direct front or rear screen projection.

1.2 The specifications are also applicable to reversal original photography.

2. *Definitions*

2.1 The safe action image area is the area within which all significant action should take place to ensure visibility of the action in the usual projection situation.

2.2 The safe title image area is the area within which the graphic information (e.g., titles, credits, tabulations, etc.) must be confined to prevent loss of this information (cropping) in the usual projection situation.

3. *Specifications*

3.1 The dimensions shall be as given in the figure and table.

3.2 For convenience, the dimensions are also expressed as a percentage of the nominal maximum projection image height and width.

3.3 The safe action and safe title areas are nominally centered within the maximum projectable image area.

3.4 The dimensions of image areas are derived from the following American National Standards:

Motion-Picture Film (8-mm Type R) — Camera Aperture Image and Usage, ANSI/SMPTE 231-1989

Motion-Picture Film (8-mm Type R) — Projectable Image Area, ANSI/SMPTE 234-1987

Motion-Picture Film (8-mm Type S) — Projectable Image Area and Projector Usage, ANSI/SMPTE 154-1988

Motion-Picture Film (8-mm Type S) — Camera Aperture Image and Usage, ANSI/SMPTE 157-1988

3.5 A format ratio of 4:3 is maintained for all areas. The maximum projectable image height is considered as the basic parameter for each format.



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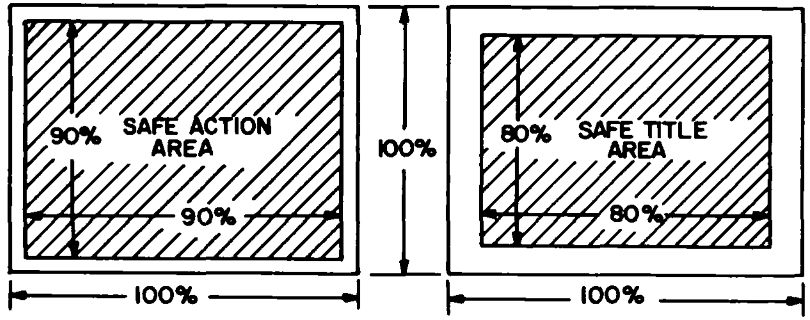


**Maximum Projectable Image Area**

Note: Safe areas are centered. True centers for all areas are established by an intersection of corner-connecting diagonal lines.

**Dimensions**

| | Maximum Projectable Area | | Safe Action Area | | Safe Title Area | | Minimum Camera Image Area | |
|---|---|---|---|---|---|---|---|---|
| | in | mm | in | mm | in | mm | in | mm |
| 8-mm Type S | | | | | | | | |
| Height | 0.158 | 4.01 | 0.142 | 3.61 | 0.126 | 3.20 | 0.163 | 4.14 |
| Width | 0.211 | 5.36 | 0.190 | 4.83 | 0.169 | 4.29 | 0.224 | 5.69 |
| 8-mm Type R | | | | | | | | |
| Height | 0.130 | 3.30 | 0.117 | 2.97 | 0.104 | 2.64 | 0.113 | 3.63 |
| Width | 0.173 | 4.39 | 0.156 | 3.96 | 0.138 | 3.51 | 0.184 | 4.67 |

# PROPOSED AMERICAN NATIONAL STANDARD

## for television analog recording —

# 1-in type C — basic system and transport geometry parameters

**SMPTE 18M**

Revision and Redesignation of ANSI V98.18M-1983



## 1. Scope

This standard specifies the general video record system, video pole tip locations, scanner parameters, scanner-guide locations, tape tension, and test conditions for 1-in type C helical-scan television analog recorders operating on the 525/60 monochrome or NTSC color systems.

## 2. Referenced Documents

This standard is intended for use in conjunction with the following documents:

SMPTE 19M, Television Analog Recording — 1-in Type C — Records

SMPTE 20M, Television Analog Recording — 1-in Type C Recorders and Reproducers — Longitudinal Audio Characteristics

ANSI/SMPTE 24M-1985, Video Recording — 1-in Reel Dimensions

ANSI/SMPTE 25M-1989, Video Recording — 1-in Magnetic Recording Tape

SMPTE RP 85-1985, Tracking Control Record for 1-in Type C Helical-Scan Video Tape Recording

SMPTE RP 86-1985, Video Record Parameters for 1-in Type C Helical-Scan Video Tape Recording

## 3. General Specifications

Tests and measurements made on the recorder to check the requirements of this standard shall be made under the following atmospheric conditions:

| | |
|---|---|
| Temperature for drum diameter | 20°C ± 1°C |
| Temperature for other tests | 20°C ± 1°C |
| Relative humidity | 50 ± 2 percent |
| Barometric pressure | 86 to 106 kPa |
| Conditioning before testing | 24h |

## 4. Video and Sync Record System

**4.1** Exactly one field of video shall be recorded during each scanner revolution. The record shall be divided into two parts, video and sync.







**4.2** The video record shall contain all active picture lines and sufficient vertical sync information for playback synchronization. Information not contained in the video record is defined as the vertical-interval dropout. (See SMPTE 19M.)

**4.3** The sync record shall contain a number of horizontal TV lines during the vertical interval including those of the vertical-interval dropout and sufficient overlap of information for playback switching. (See SMPTE 19M.)

**4.4** Recording of the sync record shall be optional; however, no other information shall be recorded in the allotted tape area.

## 5. Scanner Pole Tips

**5.1** There shall be six circumferential pole tip locations as shown in Fig. 1, top-view. When an operational pole tip is not required, a suitable nonfunctional tip shall be placed in the same location.

**5.2** Each tip projection shall be 0.06 ± 0.03 mm, measured from the outer surface of the upper drum to the end of the pole tip.

**5.3** The axial distance between each video head pole tip and its associated sync head pole tip shall be as shown in Fig. 1, side view.

## 6. Scanner Guides

**6.1** Location of the tape entrance and exit guides shall provide a tape wrap angle such that the video record vertical-interval dropout is 10.00 ± 0.25 horizontal lines due to loss of head-to-tape contact, with no electronic switching of the recording signal. Start and end of the vertical-interval dropout shall be measured at the half-amplitude points of the RF envelope.

**6.2** The helix angle formed by the scanner and all associated tape guides shall be 2°35′29″ ± 2″.

## 7. Drum Diameter and Tape Tension

Effective drum diameter, tape tension, helix angle, and tape speed completely determine the video record track angle. Different methods of design and/or minor variations in drum diameter and tape tension will produce equivalent recordings for interchange purposes. Values and operating conditions specified in this standard will produce the reference value of track angle. (See SMPTE 19M.)

**7.1** The actual upper drum diameter shall be 134.620 + 0.018 − 0.000 mm.

**7.2** The actual lower drum diameter shall be 134.580 + 0.000 − 0.018 mm.

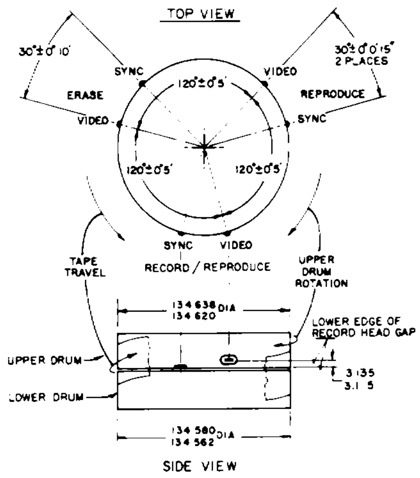


**Fig. 1**
**Pole Tip Locations and Drum Dimensions**

**7.3** The upper drum section shall rotate in synchronism with the video tips.

**7.4** The center span tape tension shall be 1.7 ± 0.3 N.

## 8. Definitions

The following definitions of terms ensure correct understanding of this standard:

**Scanner:** A mechanical assembly containing a drum, rotating pole tips, and tape-guiding elements used to record and reproduce video tape recordings.

**Drum:** A right circular cylinder around which tape is at least partially wrapped in order to form the head-to-tape interface of a video tape recording system.

**Upper Drum:** That part of the drum in a helical-scan video tape recording system which does not contact the reference edge of the tape. (See SMPTE 19M.)

**Lower Drum:** That part of the drum in a helical-scan video recording system which contacts the reference edge of the tape and usually contains tape-guiding elements. (See SMPTE 19M.)

**Effective Drum Diameter:** A value of drum diameter which when used in theoretical calculations will correspond to the actual video record produced in a helical-scan video tape recording system. The effective value is equal to or greater than the actual drum diameter.

**Helix Angle:** The angle formed between the path of the rotating pole tips and the tape reference edge-guiding system on the scanner of a helical-scan video tape recording system.

**Track Angle:** The angle of the recorded video track with respect to the reference edge of the tape in a helical-scan video tape recording. (See SMPTE 19M.)

**Center Span Tension:** A calculated value of tape tension at a point midway between tape entrance and exit guides of the scanner in a video tape recording system.





# PROPOSED AMERICAN NATIONAL STANDARD

**SMPTE 19M**

Revision and Redesignation of ANSI V98.19M-1983

## for television analog recording — 1-in type C — records



## 1. Scope

This standard specifies the dimensions and location of recorded video, audio and tracking control records for 1-in type C helical-scan television analog recorders operating in the 525/60 monochrome or NTSC color systems.

## 2. Referenced Documents

This standard is intended for use in conjunction with the following documents:

SMPTE 18M, Television Analog Recording — 1-in Type C — Basic System and Transport Geometry Parameters

CCIR Report 624-3 (MOD-F), Characteristics of Television Systems

## 3. General Specifications

**3.1** Tests and measurements made on the tape record to check the requirements of this standard shall be made under the following conditions unless otherwise specified:

| | |
|---|---|
| Temperature | 20°C ± 1°C |
| Relative humidity | 50 ± 2 percent |
| Barometric pressure | 86 to 106 kPa |
| Tape tension | 1.7 ± 0.3 N |

**3.2** *Conditioning before recording and testing* shall be as follows:

| | |
|---|---|
| Environmental | Stabilized at measurement conditions |
| Tape tension | Wound on a reel at 0.5 to 3.0 N |

**3.3** The reference edge of the tape for dimensions in this standard shall be the lower edge as shown in Fig. 1. The magnetic coating is on the side facing the observer in the figures.

## 4. Tape Speed

The tape speed shall be 244.0 ± 0.5 mm/s.

## 5. Record Location and Dimensions

**5.1** Record location and dimensions shall be as specified in Fig. 1 and Table 1.

**5.2** Dimensions P, Q, R, and θ are for reference purposes only. The parameters given in SMPTE 18M and the tape speed completely determine these values and their tolerances. The nominal values given are based on tensioned tape; therefore, direct measurement without tension must take into account tape elasticity.

## 6. Video Record Curvature

The edge of the video record shall be contained *within two parallel straight lines 0.030 mm apart.*

## 7. Relative Positions of Recorded Signals

**7.1** *Video, sync, tracking control, and audio signals* with information intended to be time coincident shall be positioned as specified in Fig. 2 and Table 1. Dimensions T, U, Y, and Z are for reference purposes only.

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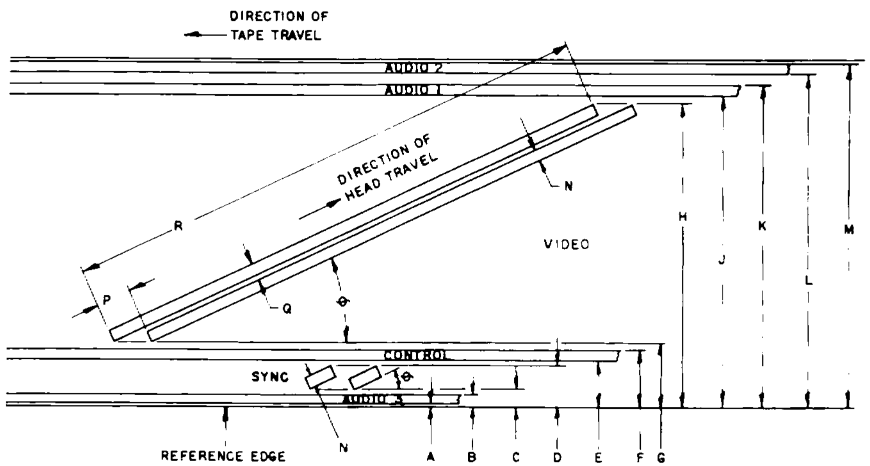


Fig. 1
Record Location and Dimensions

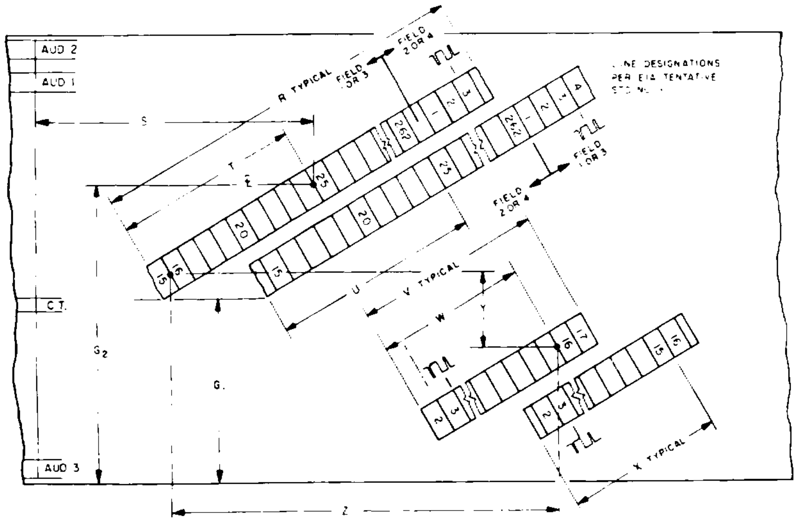


Fig. 2
Video and Sync Record Location





**Table 1**

| | Dimensions | Millimeters Minimum | Maximum |
|---|---|---|---|
| A* | Audio 3 lower edge | 0.050 | 0.150 |
| B* | Audio 3 upper edge | 0.825 | 0.975 |
| C | Sync track lower edge | 1.385 | 1.445 |
| D | Sync track upper edge | 2.680 | 2.740 |
| E | Control track lower edge | 2.870 | 3.130 |
| F | Control track upper edge | 3.430 | 3.770 |
| $G_1$ | Video track lower edge | 3.860 | 3.920 |
| $G_2$ | Video line 25 start | 4.650 | 4.710 |
| H | Video track upper edge | 22.355 | 22.475 |
| J* | Audio 1 lower edge | 22.770 | 22.830 |
| K* | Audio 1 upper edge | 23.525 | 23.675 |
| L* | Audio 2 lower edge | 24.325 | 24.475 |
| M* | Audio 2 upper edge | 25.150 | 25.250 |
| N | Video and sync track width | 0.125 | 0.135 |
| P | Video offset | 4.067 ref (2.5 H) | |
| Q | Video track pitch | 0.1823 ref | |
| R | Video track length | 410.764 ref (252.5 H) | |
| S** | Control track head distance (mechanical dimension) | 116.23 | 117.03 |
| $S_1$ | Control track head distance (tape footprint) | 114.70 | 115.10 |
| T | Vertical phase odd field | 16.270 ref (10.0 H) | |
| U | Vertical phase even field | 17.080 ref (10.5 H) | |
| V | Sync track length | 25.620 (15.75 H) | 26.420 (16.25 H) |
| W | Vertical phase odd sync field | 22.360 (13.75 H) | 23.170 (14.25 H) |
| X | Vertical phase even sync field | 23.170 (14.25 H) | 23.980 (14.75 H) |
| Y | Vertical head offset | 1.529 ref | |
| Z | Horizontal head offset | 35.380 ref | |
| θ | Track angle | 2°34′ ref | |

* See Appendix.

** Dimension S is not shown in Fig. 2. It is a physical transport dimension that should result in the footprint dimension $S_1$.

7.2 The start of the video record is that location on the video record which would be produced by scanner and guide locations with no electronic switching of the recording signal.

7.3 The vertical-interval dropout location with respect to a television frame is determined by the phase dimension, T, measured from the start of video to the negative-going edge of line 25 H-sync in odd-numbered fields.

7.4 The start and end of the sync record must be produced by electronic switching of the recording signal due to geometric constraints. (See SMPTE 18M.) Phasing of the sync record electronic switching shall be as per phase dimension W in odd-numbered fields.

7.5 Even-numbered fields have a different video and sync phasing (Dimensions U and X) due to the odd number of lines in a television frame.

## 8. Gap Azimuth

8.1 The azimuth of all head gaps used to produce longitudinal track records shall be perpendicular to the direction of relative head-to-tape motion.

8.2 The azimuth of the video and sync head gaps shall be perpendicular to the direction of head motion.

## Appendix

**(This Appendix is not part of the American National Standard, but is included for information only.)**

Dimensions A, B, J, K, L, and M have been revised to reduce audio level interchange differences. Audio head stacks produced prior to this standard may produce track records with wider tolerances.





# PROPOSED AMERICAN NATIONAL STANDARD

**SMPTE 20M**

Revision of ANSI/SMPTE 20M-1985

## for television analog recording — 1-in type C recorders and reproducers— longitudinal audio characteristics



## 1. Scope

This standard specifies the frequency response and reference level of recorders and reproducers for audio and longitudinal time and control code records for 1-in type C helical-scan television analog recording.

## 2. Referenced Documents

This standard is intended for use in conjunction with the following documents:

ANSI/SMPTE 12M-1986, Television — Time and Control Code — Video and Audio Tape for 525-Line/60-Field Systems

SMPTE 18M, Television Analog Recording — 1-in Type C — Basic System and Transport Geometry Parameters

IEEE Std 152-1953, Volume Measurements of Electrical Speech and Program Waves

## 3. Reference Levels

3.1 Recording Method. All recordings shall be made using the anhysteresis (bias) method.

3.2 Recording and Reproducing Level Indicator. The audio recording and reproducing levels of a video tape recorder shall be adjusted with a standard volume indicator, as specified in IEEE Std 152-1953, or equivalent.

3.3 Recorder Reference Level. When a recording is made from a sinusoidal signal having a frequency of 1000 Hz such that the rms short circuit tape flux per unit track width on the record is 100 ± 3 nWb/m of track width, the recording volume indicator shall be adjusted to deflect to its reference level (0 vu) scale mark.

3.4 Reproducer Reference Level. When a tape record having an rms short circuit tape flux per unit track width of 100 nWb/m and a frequency of 1000 Hz is reproduced, the reproducing volume indicator shall deflect to its reference level (0 vu) scale mark.

## 4. Frequency Response

4.1 Recorder Flux/Frequency Response. When a tape record is recorded from a constant voltage level applied to the input terminals of the recording system, the short circuit tape flux level on the record versus frequency, $L_\phi(f)$, shall be as given by the following equation:

$$L_\phi(f) = 10 \log_{10} \frac{1 + \left(\frac{F_l}{f}\right)^2}{1 + \left(\frac{f}{F_h}\right)^2} \text{ [dB]}$$

where $L_\phi$ is the relative tape flux level; f is the frequency at which the response is being computed; $F_l$ is the low-frequency transition frequency, 50 Hz; and $F_h$ is the high-frequency transition frequency, 10,610 Hz. (See Appendix A1.)

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**4.2** Reproducer Flux/Frequency Response. When a tape record having a short circuit tape flux level versus frequency given in 4.1 is reproduced, the output voltage level of the reproducer versus frequency shall be constant.

## 5. Relative Polarity

**5.1** Recording Polarity. The recording equipment, being fed a positive waveform on pin 2 at its input, will produce a positive magnetization on the magnetic recording medium. A positive magnetization is the same direction of magnetic flux flow as that observed in a bar magnet where the flux flows out of the north and into the south pole. This flux flow is in the direction of the physical movement of the magnetic surface.

**5.2** Reproduction Polarity. Reproduction of a positive magnetization on the magnetic surface will provide a positive waveform on pin 2 of an XLR-3 connector at the output of the magnetic reproduction equipment. (See Appendix A2.)

**5.3** Record/Reproduce Audio Head Phasing. When a tape record having been produced by the same signal being recorded on the audio 1 and audio 2 tracks is reproduced by individual head gaps for audio 1 track and audio 2 track, the phase difference between the audio 1 and 2 signals shall not exceed 30° at 12 kHz. (See Appendix A3.)

## 6. Track Usage

**6.1** Nonstereo Audio. The primary program audio channel shall be recorded on the audio 1 track.

**6.1.1** When the same signal is recorded on the audio 1 and audio 2 tracks, the tracks shall be so phased that, when reproduced with a head wide enough to sense the recorded flux on both records, they will be additive.

**6.2** Stereo Audio. When separate channels are used for stereo audio, the left channel shall be recorded on the audio 1 track and the right channel on the audio 2 track.

**6.3** Time and Control Code. When used, a time and control code shall be recorded on the audio 3 track.

**6.3.1** Position of the Code on the Video Tape

**6.3.1.1** The start of the address for original recording shall be as specified in ANSI/SMPTE 12M-1986.

**6.3.1.2** The position of the address start point along the tape is determined by the position of the appropriate audio head gap.

**6.3.2** Recorded Signal

**6.3.2.1** The input waveform of the recorder for original time and control code recordings shall be as specified in ANSI/SMPTE 12M-1986.

**6.3.2.2** The amplitude of the recorded signal shall be such as to produce a peak-to-peak short circuit recorded flux level on the tape of at least 141 nWb/m of track width.





## Appendix

**(This Appendix is not part of the American National Standard, but is included for information only.)**

A1. The record flux level versus frequency method given in 4.1 is equivalent to the more familiar reproduce time constant method. Transition frequencies may be calculated with the following equation:

$$F = \frac{1}{2\pi T}$$

Equivalent time constants would be:

$T_l$ = 3180 µs

$T_h$ = 15 µs

A2. A recording channel is positive when a positive pulse produces a magnetic flux flow across the recording head gap in the direction of the tape movement. A reproducing channel is positive when a positive magnetization on the tape produces a positive pulse at the output. (See Fig. 1.)

Positive polarity may be simulated in a reproducer by either of the two methods given below.

Method No. 1. Face the south pole of a magnet toward the reproduce head. Move the magnet past the head in the direction of tape movement, near enough to the head to produce an output from the reproduce channel. Observe the output of the reproduce channel on an oscilloscope. The first half cycle of the sine wave should be positive going. (See Fig. 2.) Precaution should be taken to prevent magnetization of the heads or other metal surfaces.

Method No. 2. Positive polarity may be simulated in a reproducer by passing a dc pulse through a wire which is parallel to the reproduce head gap. A practical signal for measuring polarity can be generated in an induction loop by half-wave rectifying a 400-Hz sine wave. When the positive-going half-wave current flows through the conductor up through the page toward the observer (see Fig. 3), this signal should produce a positive-going waveform at the output of the reproduce channel. (By classical definition, what is considered current flow is opposite to electron flow.) This signal may also be recorded and reproduced to verify the polarity of the record channel.

A3. Record/reproduce audio head phasing may be measured by using a single, wide head to record audio 1 track and audio 2 track simultaneously. When the signal is reproduced with individual heads, the relative phase is a measure of the accuracy of alignment of the reproduce head gaps. An example would be a relative phase not to exceed 30° in the 100 Hz to 12 kHz frequency range as stated in 5.3.

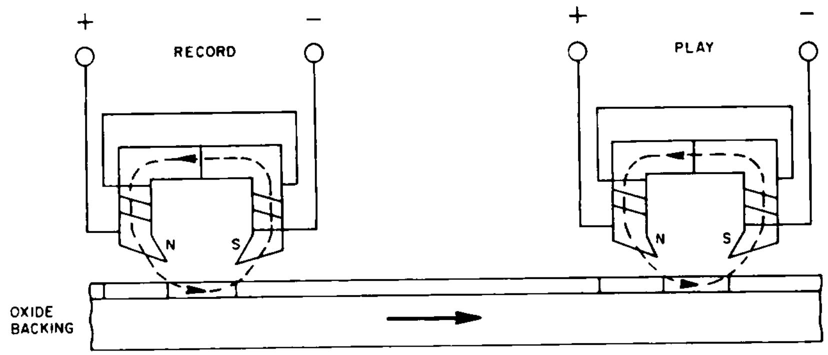


**Fig. 1**
**Orientation of Magnetic Head Gaps**

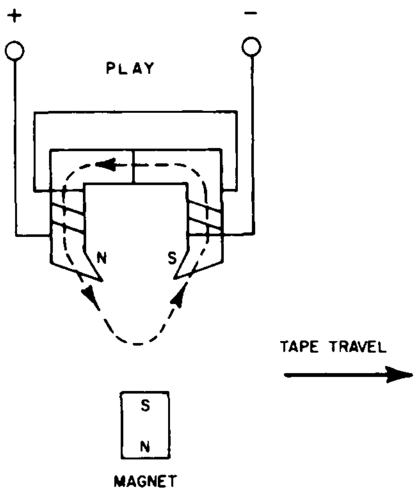


Fig. 2
Magnetic Method for Determining Polarity

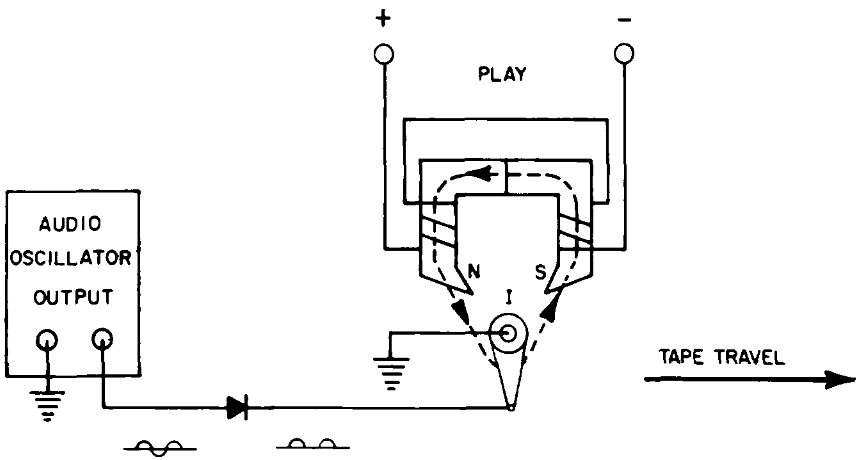


Fig. 3
Induction Loop Method for Determining Polarity



# PROPOSED
# SMPTE ENGINEERING GUIDELINE



## Video and Audio Alignment Tapes and Procedures for 1-in Type C Helical-Scan Television Analog Recorders



### 1. Scope

This guideline describes the use of a manufacturer's alignment tape(s) intended for aligning type C television analog recorders to SMPTE specifications.

### 2. Referenced Documents

The following documents are intended to be used with this guideline and consulted for detailed specifications of the type C format:

ANSI S4.6-1982, Method of Measuring Recorded Flux of Magnetic Sound Records at Medium Wavelengths

ANSI/SMPTE 12M-1986, Television — Time and Control Code — Video and Audio Tape for 525-Line/60-Field Systems

SMPTE 19M, Television Analog Recording — 1-in Type C — Records

SMPTE 20M, Television Analog Recording — 1-in Type C Recorders and Reproducers — Longitudinal Audio Characteristics

ANSI/SMPTE 26M-1989, Video Recording — 1-in Helical-Scan Recorders — Raw Stock for Reference Tapes

SMPTE RP 85-1985, Tracking-Control Record for 1-in Type C Helical-Scan Video Tape Recording

SMPTE RP 86-1985, Video Record Parameters for 1-in Type C Helical-Scan Video Tape Recording

EIA RS-189-A, Encoded Color Bar Signals

IEEE Std 152-1953, Volume Measurements of Electrical Speech and Program Waves

IEEE Std 205-1958, Television: Measurement of Luminance Signal Levels

NAB Standard for Magnetic Tape Recording and Reproducing (Reel-to-Reel)

CCIR Report 624-3 (MOD F), Characteristics of Television Systems

IEC Publication 94, Magnetic Tape Recording and Reproduction Systems: Dimensions and Characteristics

### 3. General Specifications

**3.1** Recorder. The recorder used to record this tape shall comply with SMPTE 19M.

**3.2** Record Dimensions. The dimensions of pertinent records making up this tape shall conform to SMPTE 19M.

**3.3** Tape Stock. The tape stock shall be as specified in ANSI/SMPTE 26M-1989.

**3.4** Tracking Control Signal. The tracking control signal shall conform to SMPTE RP 85-1985, except that the tolerance specified in Sec. 3.1 shall be tightened to ± 0.4 ms.

**3.5** Time and Control Code. Time and control code, if provided, shall conform to ANSI/SMPTE 12M-1986, and shall be recorded on audio 3 record. The reference flux level for time and control code shall be as defined in SMPTE 20M.

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## 4. Audio

4.1 General Notes

**4.1.1** Test Equipment. Properly calibrated test equipment including, but not limited to, an rms voltmeter as specified in IEEE Std 152-1953, or equivalent, is essential for the following tests.

**4.1.2** Procedures. All adjustments must be made with due attention to the machine manufacturer's instructions.

**4.1.3** Audio Calibration. The short circuit tape flux on the tape shall be determined by means of the calibrated short-gap ferromagnetic core reproducer technique. This technique is described in ANSI S4.6-1982 and the following references:

McKnight, J.G. Flux and flux-frequency response measurements and standardization in magnetic recording. Journal of the SMPTE. 78(6): 457-472: June 1969.

Lovick, R. C.; Bartow, R. E.; and Scheg, R. F. Recording and calibration of super-8 magnetic reproducer test films. Journal of the SMPTE. 78(6): 473-481: June 1969.

**4.2** Confidence Heads. All audio adjustments should be made to the confidence/monitor heads as well as the main record/play heads to ensure maximum quality in all modes of operation.

**4.3** Audio Signal Specifications. The following specifies the various generic signals which might be used on a tape. If signals other than these are used on a tape, the nature of the actual signals shall be carefully and fully defined.

**4.3.1** Recorded Audio Flux Level. The recorded reference level shall conform to SMPTE 20M, except that the short circuit flux recorded on the tape at each frequency shall be within ± 0.5 dB of the level specified. The tolerance, ± 0.5 dB, may be extended to ± 2.0 dB provided the manufacturer supplies a calibration chart with the tape. (See Appendix.)

**4.3.2** Audio Test Calibration. The calibration values in decibels furnished with the tape shall represent the levels to be added algebraically to the reproducer output level when the particular tape is reproduced. With the addition of these values, the output level of the reproducer in decibels will be that which would have resulted if the short circuit flux on the tape at a given frequency had been exactly as specified in SMPTE 20M.

**4.3.3** Audio Flutter. The unweighted flutter content of the recording shall not exceed 0.1 percent rms, when measured in accordance with NAB Standard for Magnetic Tape Recording and Reproducing (Reel-to-Reel).

**4.3.4** Signals. All recorded signals shall conform to SMPTE 20M unless otherwise specified.

**4.3.5** Reference Level Tone. The reference level tone shall be 1000 Hz ± 2% recorded at the reference flux level.

**4.3.6** Pink Noise. Pink noise, if recorded, shall be 10 dB below reference level.

**4.3.7** Frequency Response. The following signals, recorded 10 dB below reference level, shall be contained in this section: 1 kHZ (reference), 63 Hz, 125 Hz, 250 Hz, 1 kHz, 2 kHz, 4 kHz, 8 kHz, 10 kHz, 12.5 kHz, 16 kHz, 1 kHz. The frequency of each recorded signal shall be ± 3% of its specified value. The tones shall be recorded in the order given. Each tone shall have a duration of at least 20 seconds except the initial and final 1 kHz reference tones whose duration shall be at least 30 seconds.

**4.3.8** Azimuth/Stereo Phase. Azimuth/stereo phase shall be as specified in SMPTE 20M, but be tightened to ensure that the relative phase relationship between the audio one and audio two signals does not exceed 10 degrees within the specified range of 100 Hz to 12 kHz. The required frequencies shall be as specified in IEC 94.

**4.3.9** Crosstalk. Tones of 63 Hz, 1 kHz, and 16 kHz shall be recorded on channel one only and then channel two only. These tones shall be recorded +8 dB above reference level.

4.4 Definitions

**4.4.1** Flux Level: The absolute short-circuit recorded magnetic flux level in nanowebers per meter (nWb/m). SMPTE 20M defines the standard audio reference flux density. (See Appendix.)

**4.4.2** Frequency Response: The amplitude vs frequency characteristic of a circuit or flux given as the frequency-by-frequency deviation, in decibels, from either zero deviation or from a specified response.

**4.4.3** Azimuth: The angle, in a plane parallel to the tape, between the head gaps and a line drawn perpendicular to the reference edge of the tape.

**4.4.4** Height: The distance of a head or record, along the plane of the tape, perpendicular to the reference edge of the tape.

**4.4.5** Rotation: Rotation of a head around a line which is parallel to the plane of the tape (drawn through the centerline of the head as defined by the manufacturer) and perpendicular to the reference edge of the tape.

**4.4.6** Zenith: The angle, in a plane perpendicular to the tape, between the head gaps and a line drawn perpendicular to the reference edge of the tape.

**4.4.7** Peak Value: The true peak value of the signal, measured by observing a true peak-reading measuring device, such as an oscilloscope, and comparing the peak amplitude of the observation to the peak amplitude of the stated reference.

**4.4.8** Pink Noise: A random noise signal having equal energy in equal logarithmic frequency intervals over the bandwidth of interest.

**4.4.9** Record: The magnetic flux recorded on the tape.

4.5 Use of a Reference Level Tone

**4.5.1** Preliminary Adjustments. The reference level tone may be used for setting the preliminary head mounting adjustments, such as coarse rotation, azimuth, zenith, and height, by setting the appropriate mechanical adjustments for highest and most stable output.

**4.5.2** Channel Polarity. The reference level tone may also be used as a relative channel polarity check by using an appropriate measuring system such as an X-Y display oscilloscope or phase meter.

**4.5.3** Noise Reduction Systems. The reference level tone may also be used for calibration purposes to produce the reference voltage for setting the operating point of level-dependent noise-reduction systems.

**4.6** Use of an Azimuth Tone or Tones. While observing the output of the two main channels on an appropriate measuring device, such as a phase meter or X-Y display oscilloscope, the azimuth, rotation, and zenith controls should be adjusted to produce maximum amplitude combined with minimum phase error between the two channels. If more than one azimuth adjustment tone is provided, the initial adjustment is often performed using the lower-frequency tone with fine adjustment done using the higher-frequency tone.

(Care must be taken to avoid misadjusting azimuth by one full cycle. After final adjustment has been accomplished using the high-frequency tone, performance with the lower-frequency tone should be rechecked. Use of the pink noise azimuth alignment procedure below avoids this potential problem.)

4.7 Use of Pink Noise

**4.7.1** Azimuth. Pink noise can be used for azimuth adjustment similar to the procedure described above using discrete tones. However, pink noise has an advantage over discrete tones because it produces unambiguous results (one cannot misadjust by one full cycle).

**4.7.2** Frequency Response. Pink noise can also be used for frequency-response adjustment if the machine's output is fed to an appropriate measuring device such as a spectrum analyzer, real-time analyzer, or frequency selective voltmeter. However, because pink noise provides limited frequency resolution, and because it is a stochastic, i.e., random, signal, it does not stimulate the mechanism of fringing as greatly as do discrete sine tones.

**4.8** Uses of the Frequency Response Tones. The frequency response tones may be used for setting playback equalization for the flattest possible frequency response.

## 5. Video

**5.1** General Notes

**5.1.1** Test Equipment. A properly calibrated vectorscope and waveform monitor capable of measuring differential gain and differential phase, or equivalent test equipment, are essential for the following tests.

**5.1.2** Procedures. All adjustments must be made in conformance with the machine manufacturer's instructions.

**5.1.3** Recorded Video Parameters. The recorded video parameters shall conform to those specified in SMPTE RP 86-1985, except that the tolerance specified in Sec. 5 shall be tightened to ± 0.02 MHz and the nominal values specified in other sections shall be held as close as possible.

**5.1.4** Video Calibration. All video measurements of luminance levels shall be made in accordance with IEEE Std 205-1958.

**5.1.5** Video Signals. Video synchronizing waveforms and video amplitudes shall conform to CCIR 624-3 (MOD F).

**5.2** Video Signal Specifications. The following specifies the various generic signals which might be used in a tape. If signals other than these are used on a tape, the nature of the actual signals shall be carefully and fully defined.



**5.2.1** Color Bars. 100-percent saturated, 75-percent amplitude color bars conforming to EIA RS-189-A.

**5.2.2** Multiburst. A white pulse followed by a series of six sine-wave bursts. The white pulse width and the width of each sine-wave burst should be one-seventh the width of the scan line between the end of H blanking and the start of H blanking. The white bar level shall be at 100 IRE units ± 1 IRE unit. The axis of the burst shall be at a level of 55 IRE units ± 1 IRE unit. The peak-to-peak amplitude of the bursts shall be 90 IRE units ± 1 IRE unit. The frequencies of the bursts in time sequence shall be 500 kHz, 1.5 MHz, 2.0 MHz, 3.0 MHz, 3.58 MHz, and 4.2 MHz.

**5.2.3** Multipulse. A series of pulses whose half-amplitude duration (HAD) is to be 20T for the 1-MHz signal and 10T for the remainder. All amplitudes are to be 100 IRE units + 1 IRE unit. The frequencies are to be 1.0, 2.0, 4.0, 4.8, and 5.8 MHz.

**5.2.4** Modulated Ramp. A continuous ramp extending from 0 to 100 IRE units and repeating at a line rate. Color subcarrier having a peak amplitude of 40 IRE units ± 2 IRE units shall be added to the ramp signal.

**5.2.5** Window and Pulses. A window signal, a modulated 12.5T (1.56 microsecond) pulse, and a 2T (0.25 microsecond) sine-squared pulse. All signals shall extend from 7.5 IRE units ± 2.5 IRE units to 100 IRE units ± 1 IRE unit. The window signal shall have a 1T (0.125 microsecond) rise time.

**5.2.6** Chroma Field. A flat, full-field signal corresponding to the cyan bar of EIA RS-189-A at 75-percent amplitude.

**5.2.7** Gray Field. A flat, full-field signal at 50 IRE units.

**5.2.8** Vertical Interval Test Signals. Vertical interval test signals are located on lines 10 through 19. Some or all of the following list of signals may be added to both fields:

| | |
|---|---|
| line 10 | 2T and 12.5T pulses and 1T bar |
| line 11 | modulated ramp |
| line 12 | modulated ramp |
| line 13 | modulated ramp |
| line 14 | multiburst |
| line 15 | multiburst |
| line 17 | 2T and 12.5T pulses and 1T bar |
| line 19 | multiburst |

Results of measurements using vertical interval test signals may not be the same as full-field signals due to head-to-tape contact at the ends of the scan.

**5.3** Use of Color Bars. Color bars may be used to calibrate luminance, chrominance, and color-burst playback output amplitudes, both absolute and relative.

**5.4** Use of Modulated Ramp. Modulated ramp may be used to adjust the playback-differential gain and differential-phase performance of the VTR. Adjustment should be made to minimize both differential gain and phase.

**5.5** Use of Multiburst/Multipulse. Multiburst/multipulse may be used to adjust playback frequency response. General practice is to adjust for maximum flatness of the waveform.

## 6. Tracking Accuracy

**6.1** General Notes

**6.1.1** Test Equipment. For the following tests, a properly calibrated oscilloscope, or equivalent, is needed.

**6.1.2** Procedures. Since there is a specific adjustment procedure for each VTR, the manufacturer's instructions should be followed.

**6.2** Control-Track Phase and Level. Control-track phase and level are best adjusted using a flat-field test signal. It is recommended that a split-field signal not be used for this adjustment. The procedure is to adjust the tracking control for maximum RF output, then verify proper video and sync RF waveforms against the manufacturer's specifications. This adjustment must be performed whenever the control-track head is moved or replaced. This adjustment must be made and verified for each video head.

Finally, if a control-track level control is provided, the manufacturer's specific instructions for this adjustment should be followed.

**6.3** Track Straightness. This adjustment is especially critical to interchangeability because it adjusts the physical relationship of the rotating heads to the tape and, thereby, directly influences conformity with the SMPTE specified track format. It is essential to perform this procedure after replacing any guiding element(s) in the tape path. Inability to meet specifications dictates repair of the defective tape path components. Even though the format is tightly specified, due to differences in transport and scanner design among various manufacturers, maximum track straightness will usually be achieved with an alignment tape from the manufacturer of the machine being adjusted.

## Appendix

**(This Appendix is not part of the SMPTE Engineering Guideline, but is included for information only.)**

**Audio Recorded Flux Reference Level Considerations**

ANSI/SMPTE 20M-1985 defined the audio reference flux density as 100 nWb/m of track width. However, since many type C recorders have historically been adjusted using alignment tapes which use 85 nWb/m of track width as their reference flux density, the user should carefully consider the impact of calibrating to the 100 nWb/m standard. If the alignment tape in use does not offer this flux level as reference, an adjustment may be made to compensate. Calibrating to the 100 nWb/m level will introduce a 1.41 dB (20 log 100/85) level differential between existing tapes calibrated at 85 nWb/m and those recorded after matching the 100 nWb/m of track width reference.