ANSI/SMPTE 249M-1996
Revision of
ANSI/SMPTE 249M-1991

SMPTE STANDARD

for Television Analog Recording — 1/2-in Type M-2 — Records

1 Scope

This standard specifies the dimensions and locations of the video, audio, time code, and tracking-control records, as recorded by 1/2-in type M-2 helical-scan video tape recorders operating with video signals having a typical scanning structure of 525 lines, 59.94 fields/s, 2:1 interlace, and utilizing the video cassettes specified in ANSI/SMPTE 250M. This standard also specifies the records for two different audio recording modes — common audio mode and pulse code modulation (PCM) audio mode.

2 General specifications

2.1 All dimensions are in the metric system.

2.2 A basic dimension is a fundamental dimension to which no tolerance is applicable.

2.3 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)%
- Barometric pressure: 86 kPa to 106 kPa
- Tape Tension: 0.31 N ± 0.05 N

2.4 Conditioning of the tape stock before recording and testing shall be as follows:

- Environment: Established to the conditions specified in 2.3
- Tape tension: Wound on a reel at a tension of 0.4 N ± 0.1 N
- Condition time: 24 hours

2.5 The reference edge of the tape for dimensions specified in this standard shall be the lower edge as shown in figures 1 to 4. The magnetic coating, with the direction of tape travel as shown in figures 1 to 4, is on the side facing the observer.

3 Tape speed

The tape speed shall be 67.693 mm/s, basic.

4 Record locations and dimensions

4.1 The locations and dimensions of the video and common audio mode records shall be as specified in figures 1 and 2 and table 1.

4.2 The locations and dimensions of the video and PCM audio mode records shall be as specified in figures 3 and 4 and table 2. The PCM records are recorded by the luminance and chrominance heads and only a single longitudinal audio record shall be available.

4.3 Dimensions O, P, Q, R, W, W′, and PE are shown for reference purposes only. The actual value of these dimensions is determined by the tape speed, the transport parameters, and their tolerances.

The tape speed of 67.693 mm/s basic shall result in angle θ as shown. The nominal values given are based on tensioned tape; therefore, direct measurements without tension must take into account tape elasticity.

American National Standard

Approved
November 29, 1996

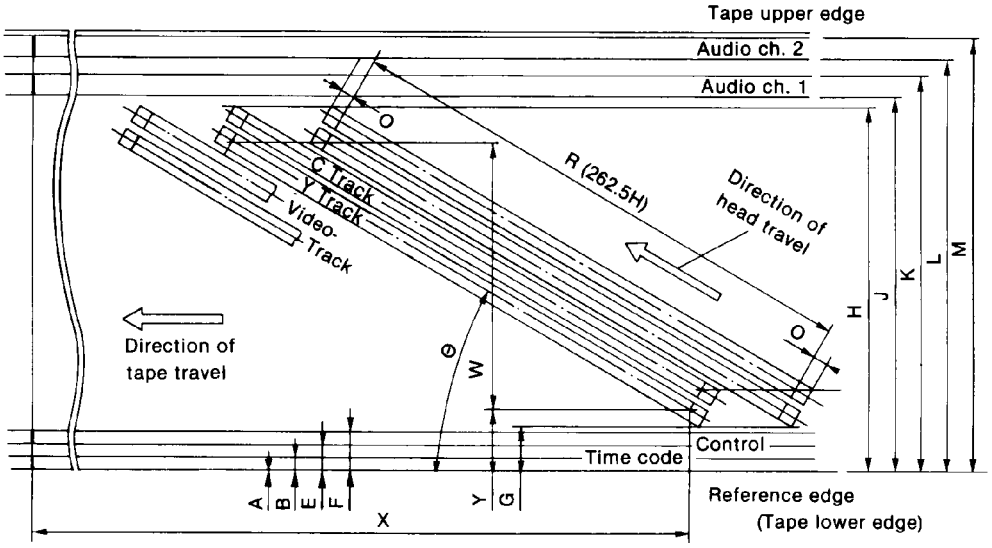


Figure 1 -- Record locations and dimensions (common audio mode)

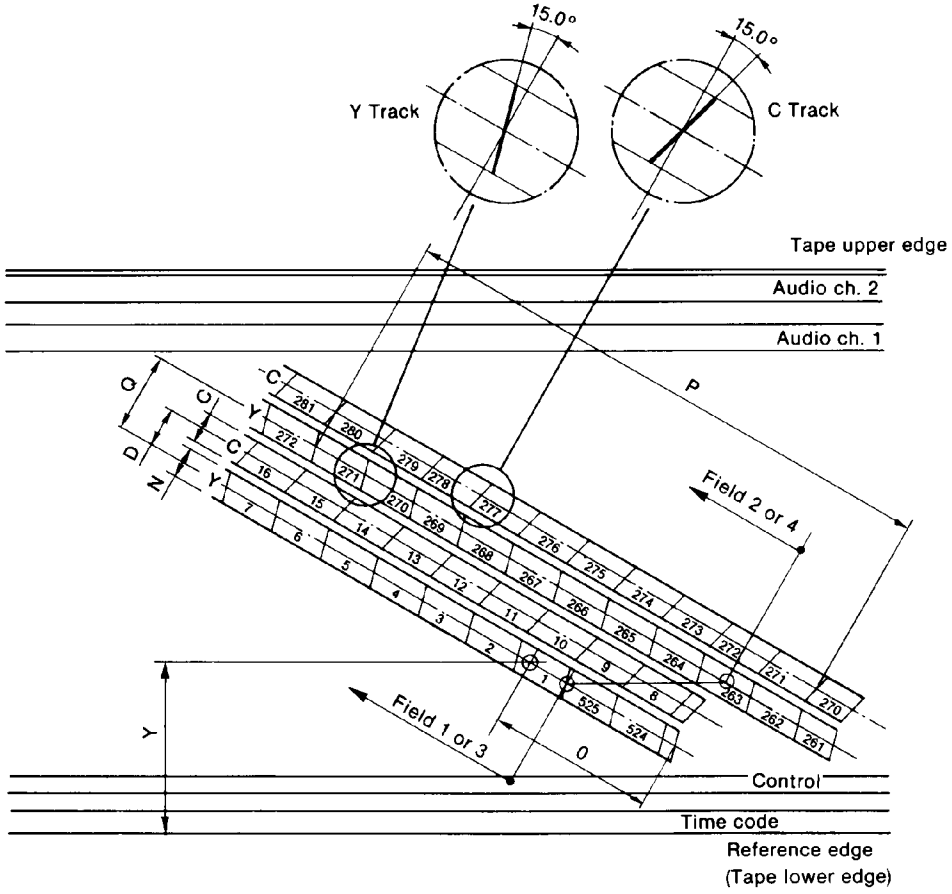


Figure 2 -- Video record locations (common audio mode)

Table 1 -- Record locations and dimensions (common audio mode)

	Dimensions	Micrometers Minimum	Nominal	Maximum
A	Time code track lower edge	0	0	0
B	Time code track upper edge	400	450	500
C	Color track width	34	36	38
D	Y-C track pitch	40.7	42.2	43.7
E	Control track lower edge	850	900	950
F	Control track upper edge	1250	1300	1350
G	Video track lower edge	1469	1503	1537
H	Video track upper edge	10601	10634	10668
J	Audio 1 track lower edge	10830	10850	10870
K	Audio 1 track upper edge	11400	11450	11500
L	Audio 2 track lower edge	11900	11950	12000
M	Audio 2 track upper edge	12500	12550	12650
N	Y track width	42	44	46
O	Lead signal overlap		3H ref	
P	Y-C track offset		4505 (= 10H) ref	
Q	Video track pitch		84.5 ref	
R	Video track length		118254.3 (262.5H) ref	
W	Video area effective width		8847.1 ref	
X	Audio, time code, and control track record offset		202000	
Y	Lower limit of W	1621	1626	1631
θ	Track angle		4.2906° (basic)	

NOTE -- "Ref" indicates those measurements which are fixed by other parameters and are given for reference purposes only.

5 Video record curvature

The edge of any video record contained within an area defined by dimension W or the edge of any video and PCM audio record contained within an area defined by dimension W′ shall be contained within two parallel straight lines 0.006 mm apart (see annex A).

6 Relative positions of signal records

Video luminance, color difference, tracking-control, longitudinal audio, and time code signals, with information intended to be time coincident, shall be positioned as shown in figures 1 to 4. PCM audio shall be positioned as shown in figures 3 and 4.

7 Gap azimuth

7.1 The azimuth of the audio, tracking-control, and time code head gaps used to produce longitudinal track records shall be perpendicular to the direction of relative head-to-tape motion (see figures 1 and 3).

7.2 The azimuth of the video head gaps for the luminance signal shall be --15.0^{o} and for the color-difference signals shall be +15.0^{o} to the perpendicular of the direction of head motion (see figures 2 and 4).

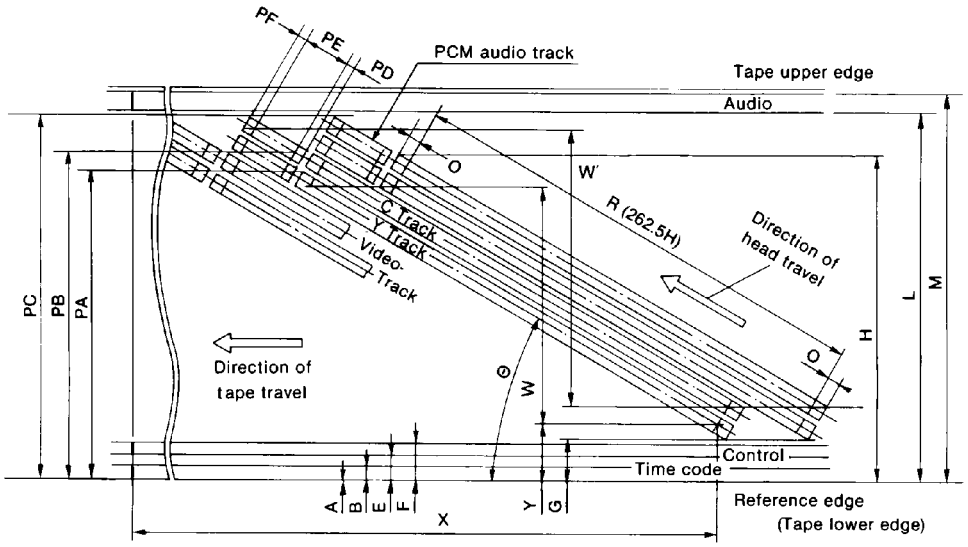


Figure 3 -- Record locations and dimensions (PCM audio mode)

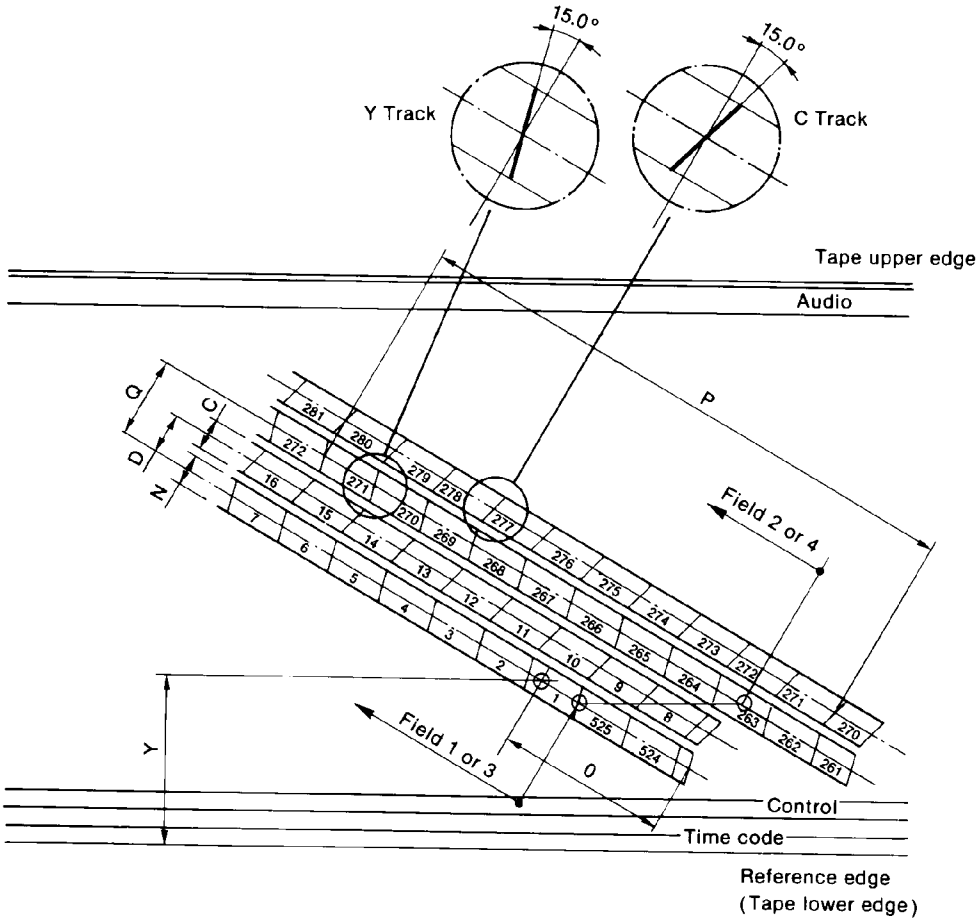


Figure 4 -- Video record locations (PCM audio mode)

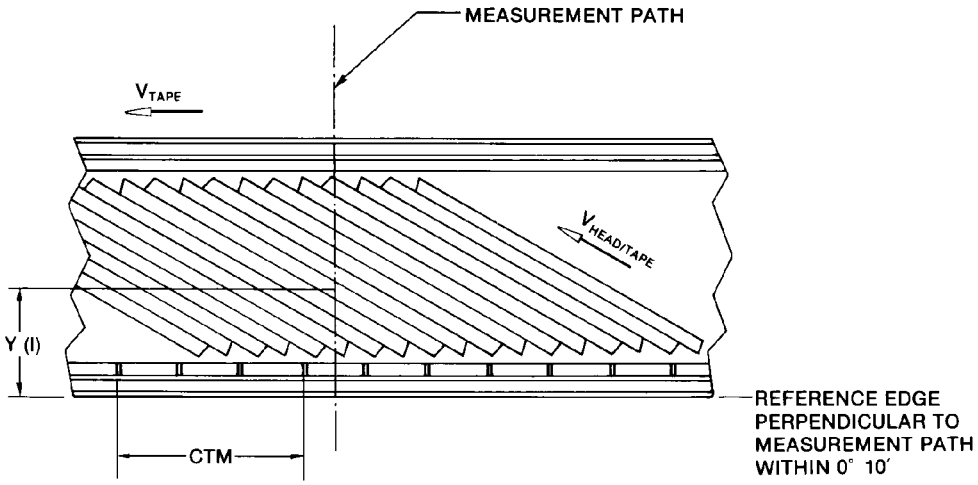
Table 2 -- Record locations and dimensions (PCM audio mode)

	Dimensions	Micrometers Minimum	Nominal	Maximum
A	Time code track lower edge	0	0	0
B	Time code track upper edge	400	450	500
C	Color track width	34	36	38
D	Y-C track pitch	40.7	42.2	43.7
E	Control track lower edge	850	900	950
F	Control track upper edge	1250	1300	1350
G	Video track lower edge	1469	1503	1537
H	Video track upper edge	10601	10634	10668
L	Audio track lower edge	11900	11950	12000
M	Audio track upper edge	12500	12550	12650
N	Y track width	42	44	46
O	Lead signal overlap		3H ref	
P	Y-C track offset		4505 (= 10H) ref	
Q	Video track pitch		84.5 ref	
R	Video track length		118254.3 (262.5H) ref	
W	Video area effective width		8847.1 ref	
W′	Video and PCM audio (CH6) area effective width		9973.5 ref	
X	Audio, time code, and control track record offset		202000	
Y	Lower limit of W	1621	1626	1631
θ	Track angle		4.2906° (basic)	
PA	Effective PCM audio track lower edge (luminance head)	10676	10709	10743
PB	Effective PCM audio track lower edge (chrominance head)	10724	10758	10791
PC	PCM audio track upper edge (chrominance head)	11660	11693	11727
PD	Preamble	360	450	541
PE	PCM audio data area		11820 ref	
PF	Postamble	360	450	541

NOTE -- “Ref” indicates those measurements which are fixed by other parameters and are given for reference purposes only.

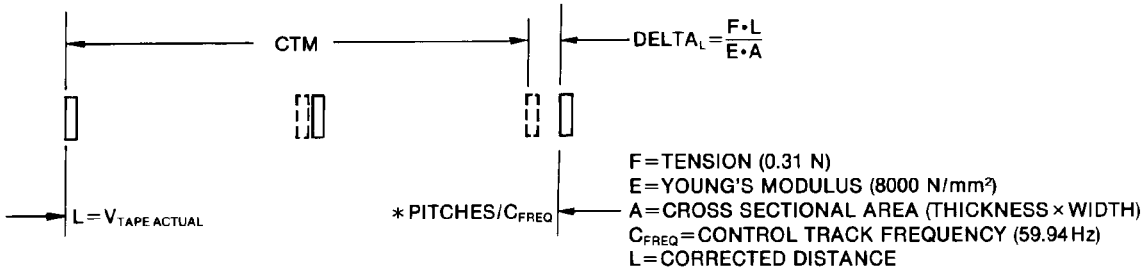
Annex A (normative)
Cross tape track measurement technique (preferred)

MEASUREMENT TECHNIQUE



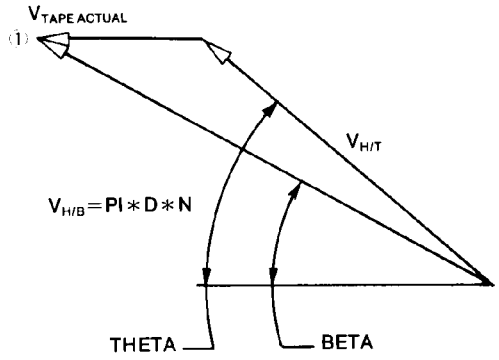
Y (I) MUST USE SAME HEAD FOR EACH MEASUREMENT (i.e. EVERY 2nd TRACK)
CTM = CONTROL TRACK PULSES (UNTENSIONED TAPE)

CORRECTION FACTORS ACTUAL TAPE SPEED, TENSION

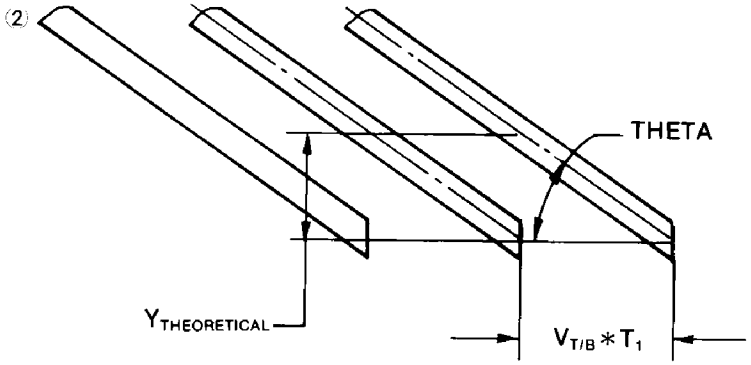


$$V_{TAPE\ ACTUAL} = CTM * C_{FREQ} / ((1 - F/(E * A)) * PITCHES)$$

MODEL



$V_{H/B}$ = VELOCITY OF HEAD wrt BAND
$V_{TAPE\ ACTUAL}$ = ACTUAL VELOCITY of TAPE
$V_{H/T}$ = VELOCITY of HEAD wrt TAPE
D = EFFECTIVE SCANNER DIAMETER
N = SCANNER SPEED ($\frac{REV}{S}$)
THETA = TRACK ANGLE
BETA = SCANNER HELIX ANGLE



T_1 = TIME BETWEEN HEAD PASSES

$$= \frac{1}{N * HPPR}$$

HPPR = HEAD PASSES per REVOLUTION

FROM ①

$$TAN\ (THETA) = \frac{PI * D * N * SIN\ (BETA)}{PI * D * N * COS\ (BETA) - V_{TAPE\ ACTUAL}}$$

FROM ②

$$TAN\ (THETA) = \frac{Y_{THEORETICAL}}{V_{TAPE\ ACTUAL} * T_1}$$

THEREFORE:

$$Y_{THEORETICAL} = \frac{PI * D * N * SIN\ (BETA)}{PI * D * N * COS\ (BETA) - V_{TAPE\ ACTUAL}} * V_{TAPE\ ACTUAL} * T_1$$

$$TRACK\ LOCATION\ ERROR = Y\ (I) - Y\ (I)_{THEORETICAL}$$

Annex B (informative)
Bibliography

ANSI/SMPTE 250M-1996, Television Analog Recording — 1/2-in Type M-2 — Tapes and Cassettes

ANSI/SMPTE 251M-1996, Television Analog Recording — 1/2-in Type M-2 — Electrical Parameters of Video, Audio, Time and Control Code and Tracking Control

ANSI/SMPTE 252M-1996, Television Analog Recording — 1/2-in Type M-2 — Pulse Code Modulation Audio

SMPTE RP 158-1991 (R1995), Basic System and Transport Geometry Parameters for 1/2-in Type M-2 Format