ANSI/SMPTE 245M-1993

SMPTE STANDARD

for Television Digital Recording — 19-mm Type D-2 Composite Format — Tape Record

1 Scope

This standard specifies the dimensions and location of the audio, video, ancillary data, cue track, time code, and control-track records for 19-mm type D-2 helical-scan composite digital cassette television tape recorders operating on the 525/60 television system encoded according to ANSI/SMPTE 244M.

2 General specifications

2.1 Dimensions are in the metric system.

2.2 Tests and measurements made on the tape record to check the requirements of this standard shall be made under the following atmospheric conditions unless otherwise stated:

- Temperature 20°C ± 1°C
- Relative humidity (50 ± 2)%
- Barometric pressure 96 kPa ± 10 kPa
- Tape tension 0.70 N ± 0.05 N

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

- Time of conditioning: Not less than 24 hours

- Environmental: Stabilized to the conditions specified in 2.2

- Tape tension: Wound on a reel at a tension of 0.6 N to 1.5 N

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

2.4.1 All dimensions in the table and figures shall be measured from an equivalent reference edge. The tape reference edge is a line through three points on the edge of tape constrained to lie in one straight line. This constraint may be a physical deformation or an equivalent mathematical transformation. The first and third points shall be separated by a measurement distance (MD) of 210 mm. The second point shall be located a distance 0.2 MD from the first point and 0.8 MD from the third point as shown in figure 3. The program reference point lies on a line perpendicular to the reference edge through the second point on the reference edge.

2.4.2 Measuring techniques are shown in annex A.

2.4.3 As indicated in figure 1, this standard anticipates the use of overlap recording by helical tape record heads of width greater than the track pitch.

3 Tape speed

The basic value for tape speed is 131.700 mm/s. The tape speed tolerance is ± 0.2%.

4 Record location and dimensions

4.1 Record location and dimensions for continuous recording shall be as specified in figures 1 and 2 and table 1.

4.2 In recording, sector locations on each helical track shall be contained within the tolerance specified in table 1 and figure 3.

4.3 The width and height tolerances of the heads used for recording shall be chosen so as to ensure

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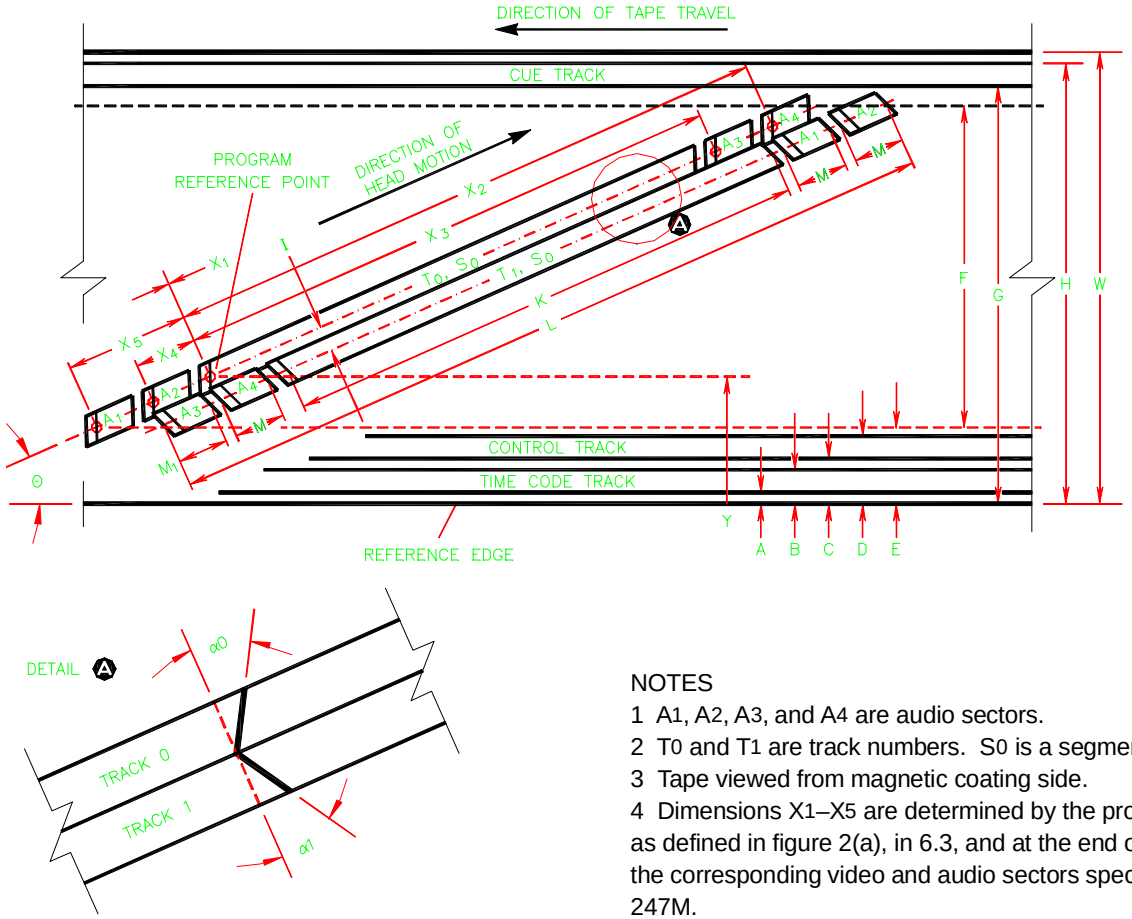


NOTES

1 A1, A2, A3, and A4 are audio sectors.

2 T0 and T1 are track numbers. S0 is a segment number (typical).

3 Tape viewed from magnetic coating side.

4 Dimensions X1–X5 are determined by the program reference point as defined in figure 2(a), in 6.3, and at the end of the preambles of the corresponding video and audio sectors specified in ANSI/SMPTE 247M.

Figure 1 – Location and dimensions of recorded tracks

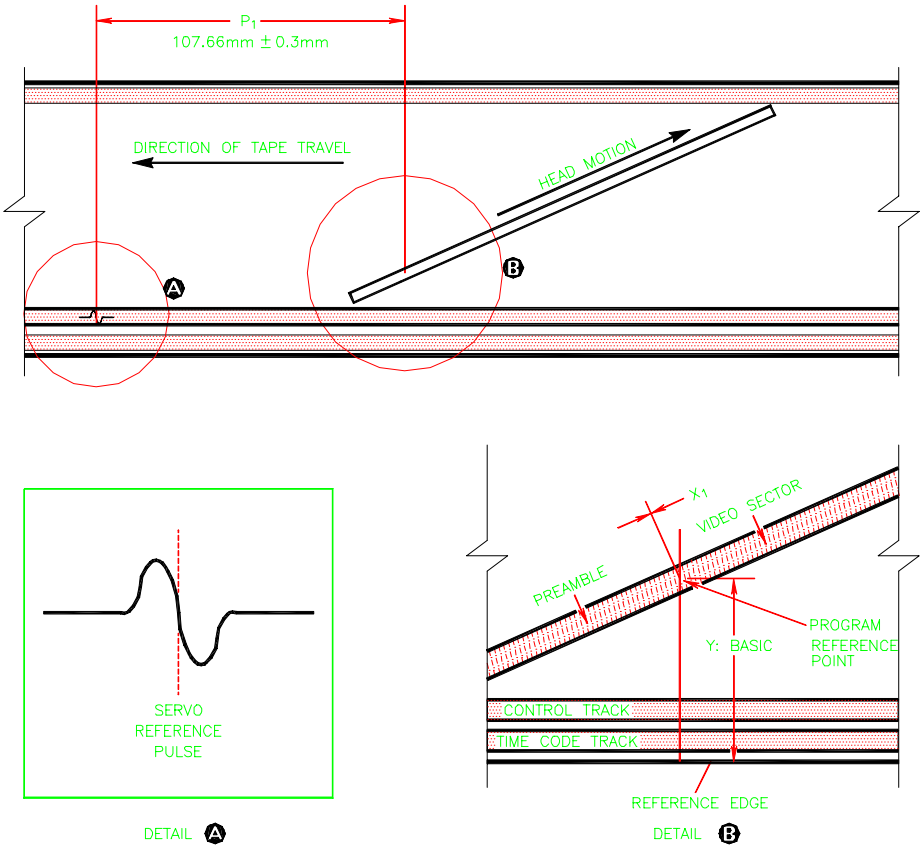


Figure 2(a) – Location of control track record

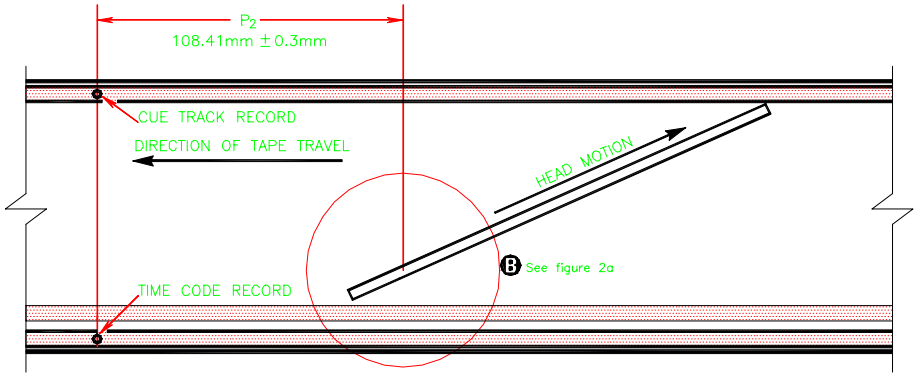


Figure 2(b) – Location of cue/time code record

Table 1 – Record location and dimensions

	Dimensions		Millimeters Nominal	Tolerance
A	Time code track lower edge		0.2	± 0.1
B	Time code track upper edge		0.7	± 0.1
C	Control track lower edge		1.0	± 0.1
D	Control track upper edge		1.50	± 0.05
E	Program area lower edge		1.807	Derived
F	Program area width		16.1	Derived
G	Cue track lower edge		18.2	± 0.1
H	Cue track upper edge		18.9	± 0.1
I	Helical track pitch		0.0391	± 0.0030
K	Video sector length		132.49	Derived
L	Helical track total length		150.78	Derived
M_1	Audio sector A_1 track 0 and A_3 track 1		4.13	Derived
M	All other audio sectors		4.01	Derived
P_1	Control pulse distance		107.66	± 0.30
P_2	Cue/time code distance		108.41	± 0.30
W	Tape width		19.010	± 0.015
X_1	Location of video sector		0	± 0.10
X_2	Location of start of audio sector A_4		137.57	± 0.10
X_3	Location of start of audio sector A_3		133.03	± 0.10
X_4	Location of start of audio sector A_2		4.54	± 0.10
X_5	Location of start of audio sector A_1		9.08	± 0.10
Y	Program reference point		2.80	Basic
θ	Track angle	6.1296°		
$\alpha 0$	Track 0 azimuth angle	+14.97° ± 0.17°		
$\alpha 1$	Track 1 azimuth angle	–15.03° ± 0.17°		

NOTE – Above dimensions shall apply under the conditions specified in 2.2.

zero guard band between recorded tracks. If a guard band is present it shall not exceed 4 μm nor contain any previously recorded information. The minimum track width after recording is 35 μm measured across the track in a line perpendicular to the centerline of the tracks.

5 Helical track record curvature

5.1 The centerlines of any four consecutive tracks shall be contained within the pattern of the four tolerance zones established in figure 3.

5.2 Each zone is defined by two parallel lines which are inclined at an angle of 6.1296° basic with respect to the tape reference edge.

5.3 The centerlines of all zones shall be spaced 0.0391 mm basic apart. The width of the first zone shall be 0.008 mm basic. The width of zones 2 through 4 shall be 0.012 mm basic. These zones are established to contain track angle errors, track straightness errors, and track pitch errors. (See annex A.)

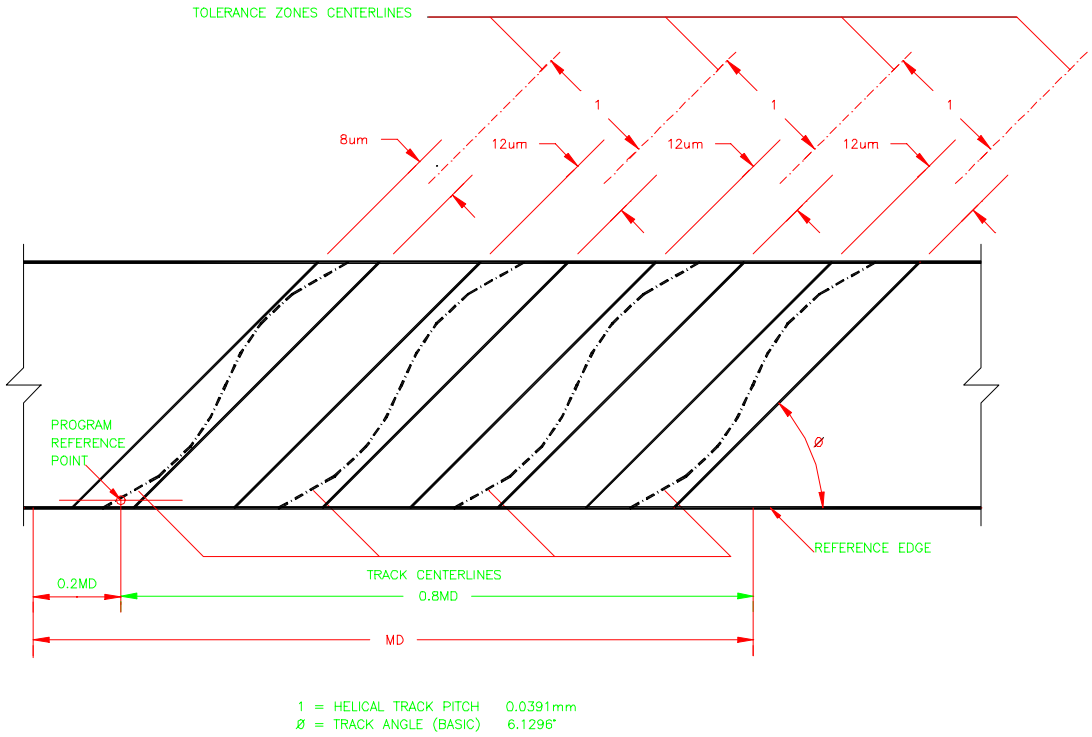


Figure 3 – Location and dimensions of tolerance zones of helical track record

6 Relative positions of recorded signals

6.1 Audio, video, and ancillary data, tracking control, time code, and cue track, with information intended to be time coincident, shall be positioned as shown in figures 1 and 2.

6.2 The spatial relationship between the cue track record, time code record, control track record, and helical tracks is specified in figures 1 and 2.

6.3 The program reference point is determined by the intersection of a line parallel to the reference edge of the tape at the distance Y and the centerline of each track in each video field (segment 0, track 0). The end of the preamble and the video sector shall be recorded at the program reference point and the tolerance is the dimension X_1. The locations are shown in figures 1 and 2. Dimensions X_1 and Y are given in table 1. The relationship between sectors and contents of each sector is specified in ANSI/SMPTE 247M.

7. Gap azimuth

7.1 The cue, control track, and time code head gaps used to produce longitudinal track records shall be perpendicular to the track record.

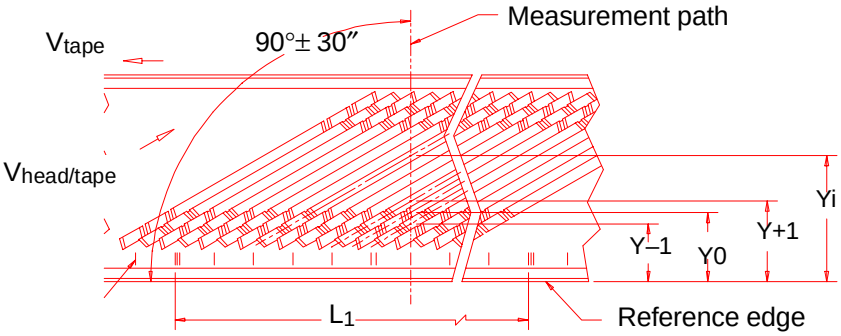
7.2 The azimuth of the head gaps used for the helical track recording shall be inclined at angles $\alpha 0$ and $\alpha 1$, as specified in table 1, perpendicular to the helical track record. The azimuth of the first track of every field (segment 0, track 0) shall be oriented in the clockwise direction with respect to the line perpendicular to the track direction when viewed from the side of the tape containing the magnetic record.

Annex A (normative)
Cross-tape track measurement technique

The cross-tape measuring technique utilizes the fact that all tracks of a helical-scan video recording, recorded by the same head at constant tape speed, have the same longitudinal track pitch, the same track angle, and the same track curvature.

From a ferrofluid development, measurements are made of the actual track positions and of the distance between a minimum of 201 control track servo reference pulses (200 control track pitches minimum) (see L_1, figure A.1). All measurements are made under the environmental conditions described in clause 2.2 except that the measurements are made without tape tension (see figure A.1). The tape is then mathematically stretched to account for tape tension (see figure A.2). The theoretical track position is calculated from the corrected longitudinal track pitch and the theoretical track angle. The track location error is calculated as the difference between the theoretical track position and the actual track position (see figure A.3).

Track location error includes track angle errors, track straightness errors, and track pitch errors. The starting point for calculations and measurements is, for example, the program reference point. The values for each fourth track are the errors for tolerance zone one; shifting one track, the second tolerance zone can be measured and so on. It is not necessary to measure all tracks; a suitable number is 20 samples per zone. A plot of the track location error against the track number shall be computed (see figure A.4). The peak-to-peak value shall lie within the tolerance zones according to clause 5.3.



NOTES
1 i is the track number (i = 0 for the track containing the program reference point).
2 Y_i is the actual track position (measured from the reference edge of the tape).
3 L_1 is the distance of n control track pitches (n = 200 minimum).

Figure A.1 – Measurement of ferrofluid tape development

The measured distance, L_1, must be corrected for tape tension. The corrected tape length, L_2 (for n control track pitches), is:

$L_2 = L_1 \times (1+T/(A \times E))$

where

T is the tape tension (0.7 N)
A is the tape cross section area (0.013 mm × 19.01 mm)
E is Young's modulus (10 000 N/mm^2).

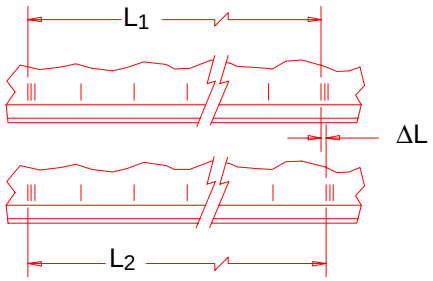
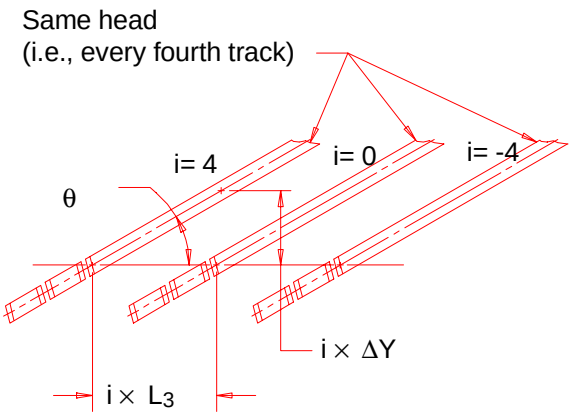


Figure A.2 – Correction for tape tension



The corrected longitudinal track pitch, L_3, is:

$L_3 = L_2/(n \times q)$

where

L2 is the corrected tape length for n control track pitches;
q is the number of tracks per control track pitch (2).

The cross track pitch, ΔY, is:

$\Delta Y = L_3 \times \tan(\theta)$

where

L_3 is the corrected track length;
θ is the theoretical track angle (6.1296°).

The theoretical track position, Y_{it}, to any track i is:

$Y_{it} = Y + (i \times \Delta Y)$

where

Y is the distance to the program reference point (2.80 mm);
i is the track number (i = 0 for the track containing the program reference point);
ΔY is the cross tape track pitch.

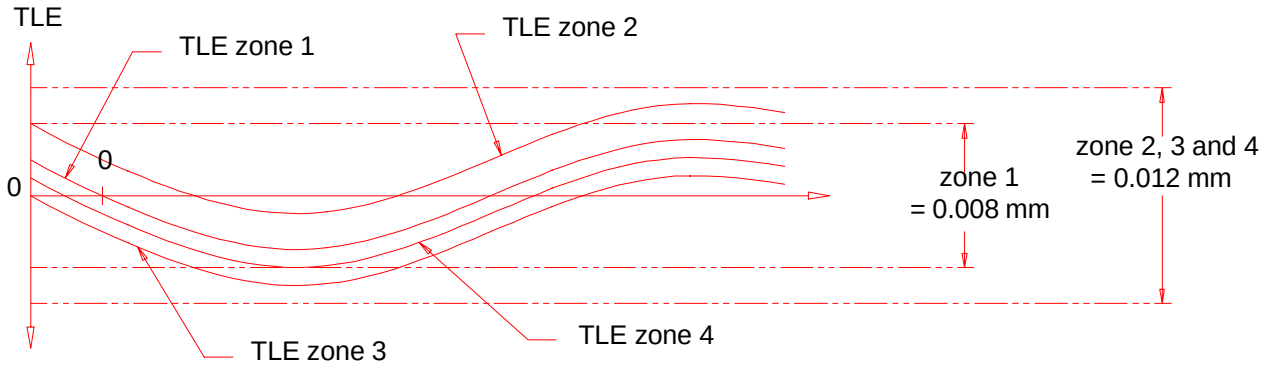
The track location error, TLE, is calculated as:

$TLE = Y_i - Y_{it}$

where

Y_i is the actual track position of track i;
Y_{it} is the theoretical track position of track i.

Figure A.3 – Calculation of track location error



NOTES

1 For tolerance zone 1: i = ... –4, 0, +4, +8 ....
2 For tolerance zone 2: i = ... –5, –1, +3, +7 ....
3 For tolerance zone 3: i = ... –6, –2, +2, +6 ....
4 For tolerance zone 4: i = ... –7, –3, +1, +5 ....

Figure A.4 – Example plot of track location error versus track number

Annex B (informative)
Bibliography

ANSI/SMPTE 244M-1993, Television — System M/NTSC Composite Video Signals — Bit-Parallel Digital Interface

ANSI/SMPTE 246M-1993, Television Digital Recording — 19-mm Type D-2 Composite Format — Magnetic Tape

ANSI/SMPTE 247M-1993, Television Digital Recording — 19-mm Type D-2 Composite Format — Helical Data and Control Records

ANSI/SMPTE 248M-1993, Television Digital Recording — 19-mm Type D-2 Composite Format — Cue Record and Time and Control Code Record

SMPTE EG 20-1993, Tape Transport Geometry Parameters for 19-mm Type D-2 Composite Format for Television Digital Recording

SMPTE EG 21-1993, Nomenclature for Television Digital Recording of 19-mm Type D-1 Component and Type D-2 Composite Formats