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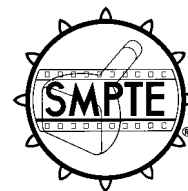
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SMPTE STANDARD

for Television Digital Recording — 19-mm Type D-6 — Helical Data, Longitudinal Index, Cue and Control Records



Page 1 of 22 pages

1 Scope

1.1 This standard specifies the format and recording method of the data blocks and associated data which form the helical records on 19-mm tape in cassettes as specified in SMPTE 226M. The data recorded may be digital video and audio data of various image standards up to approximately 1 Gbit/s as specified in ANSI/SMPTE 278M.

1.2 Also specified are the content, format, and recording method of the longitudinal record containing tracking information for the scanning heads associated with the helical records, and the longitudinal index and cue tracks.

1.3 In addition, this standard specifies the principal properties of the magnetic tape used for 19-mm type D-6 digital recording.

2 Normative reference

The following standard contains provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the edition indicated was valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent edition of the standard indicated below.

ANSI/SMPTE 278M-1996, Television Digital Recording — 19-mm Type D-6 — Content of Helical Data and Time and Control Code Records

3 Measurement environment

3.1 Dimensions are in the metric system.

3.2 Tests and measurements made on the system to check the requirements of this standard shall be carried out under the following conditions:

- Temperature: $20^{\circ}\text{C} \pm 1^{\circ}\text{C}$
- Relative humidity: $(50 \pm 2)\%$
- Barometric pressure: $96 \text{ kPa} \pm 10 \text{ kPa}$
- Tape conditioning: Not less than 24 hours
- Center span tension: $0.65 \text{ N} \pm 0.05 \text{ N}$

4 Tape specification

4.1 Base

The base material shall be polyester or equivalent.

4.2 Width

The tape width shall be $19.010 \text{ mm} \pm 0.015 \text{ mm}$.

4.2.1 The tape, covered with a glass plate, shall be measured without tension at a minimum of five different positions along the tape using a calibrated microscope or profile projector having an accuracy of at least $1.0 \mu\text{m}$. Tape width is defined as the average of the five readings.

4.3 Width fluctuation

Width fluctuation shall not exceed $6 \mu\text{m}$ p-p.

4.3.1 Measurement of width fluctuation shall be over a tape length of 900 mm at least 1 m from the beginning of the tape. The width fluctuation shall be evaluated by measuring the tape width at 10 points, each separated by a distance of 100 mm.

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4.4 Reference edge straightness

The reference edge straightness maximum deviation is $6\text{ }\mu\text{m p-p}$.

4.4.1 Edge straightness fluctuation is measured at the edge of a moving tape guided by three guides having contact with the same reference edge and having a distance of 125 mm from the first to the second guide, and 125 mm from the second to the third guide. Edge measurements are averaged over 10-mm lengths and are made near the midpoint between the first and second guide which is 62.5 mm from the first guide.

4.5 Tape thickness

The magnetic tape used shall have a thickness of $11\text{ }\mu\text{m} + 0\text{ }\mu\text{m} - 0.8\text{ }\mu\text{m}$.

4.6 Transmissivity

Transmissivity shall be less than 5%, measured over the range of wavelengths 700 nm to 900 nm.

4.7 Offset yield strength

Offset yield strength shall be greater than 14 N.

4.7.1 The force to produce 1% elongation of a 200-mm test sample with a pull rate of 100 mm per minute shall be used to confirm the offset

yield strength. The initial tangential slope is extended and read at 1% elongation.

4.8 Magnetic coating

The magnetic tape used shall have a metal particle coating or equivalent.

4.8.1 The coating coercivity shall be a class 1700 Oe (135300 A/m), as measured by a VSM or a 50/60-Hz BH meter.

4.8.2 The metal particles shall be longitudinally oriented.

5 Track arrangements

5.1 Definitions

5.1.1 block: A packet of data including the preceding synchronization and identification information. All blocks of one recording configuration have the same number of bytes.

5.1.2 cluster: An array of eight adjacent tracks (see figure 1). The numbering of the clusters starts with cluster 0 at the program reference point.

5.1.3 data field: A group of segments which starts with cluster 0 as defined by the program reference point (see figure 1). Up to four data fields (0 ... 3) may be defined. The start of even-numbered data fields coincides with the two data field pulse as defined in 9.2.8.

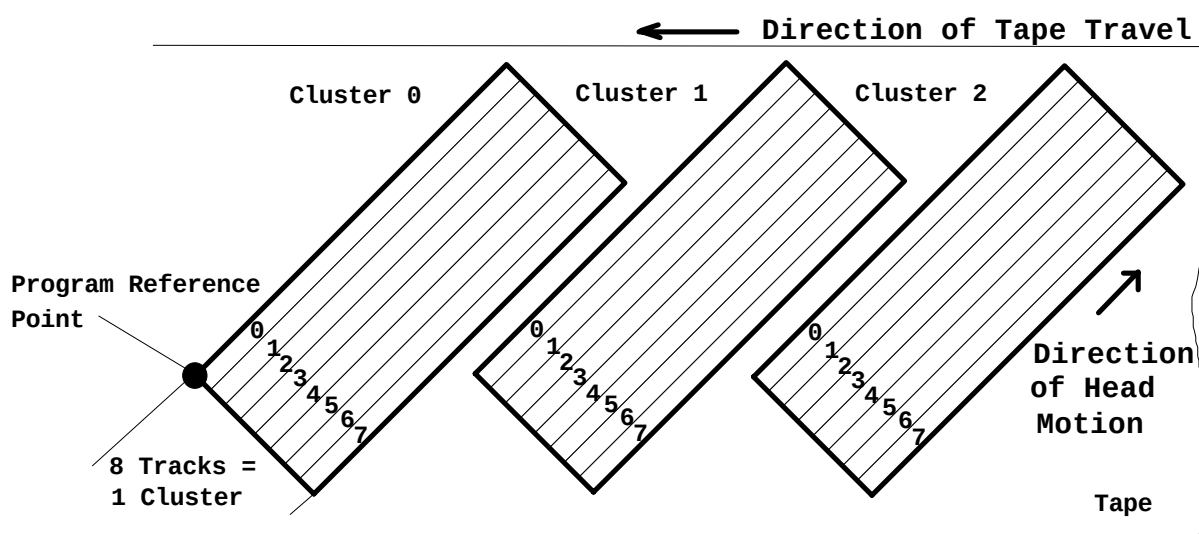


Figure 1 – Cluster of tracks

5.1.4 sector: Part of a cluster created by partitioning of all eight tracks in the same way (see figures 2 and 3). Each part of a partitioned track will start with a preamble and end with a postamble.

5.1.5 segment: A group of sectors. The format allows a segment to contain sectors of different clusters. Two possible examples are shown in figures 2 and 3.

5.1.6 track: A track contains 270 blocks. Blocks within a track are numbered 1 through 270 in the direction of recording. The first block is a preamble and the 270th block is a postamble. Tracks are numbered 0 to 7 as shown in figure 1.

5.2 Data configurations

All recorded blocks along a slant track have the same size in order to record a data pattern independent of any video-, audio-, and edit-gap parts of the track.

The total number of bytes per block depends on the recording configuration. For a given configuration, all blocks contain the same number of bytes. Two configurations are allowed:

- Configuration I: Total block length = 229 bytes;
- Configuration II: Total block length = 239 bytes.

All blocks consist of data preceded by a synchronization pattern, SYNC (see figure 4). Sync is not subject

to channel modification and is 24 bits on tape. This is equivalent to the length of two data bytes before channel modulation. The 24-bit sync pattern may be unique and not contained in the modulation tables given in clause 11. The task of the sync is to synchronize the channel decoder and to control word and block synchronization. The sync depends on the recorded data or video standard.

Two types of data are used: inner code blocks and preambles/ postambles.

The inner code blocks contain the RData bytes and the preceding block identification (ID), both protected by check bytes (see figure 5). For details of the error protection, see ANSI/SMPTE 278M.

The preambles/postambles contain a runup pattern of 224 (234) bytes of CC(hex) preceded by a block identification (ID) (see figures 6 and 7). Preambles/postambles are of sufficient length to make additional edit gaps unnecessary. Preambles and postambles may be altered on tape by editing within a cluster without any negative effects.

The identification (ID) bytes within each block contain the block-, track-, segment-, and field-numbering, as well as some bits to identify the recorded data or video standards (see figure 8). Each block has a three-byte ID (ID 0, ID 1, ID 2) which will also be protected by the check bytes. ID 0 is recorded first.

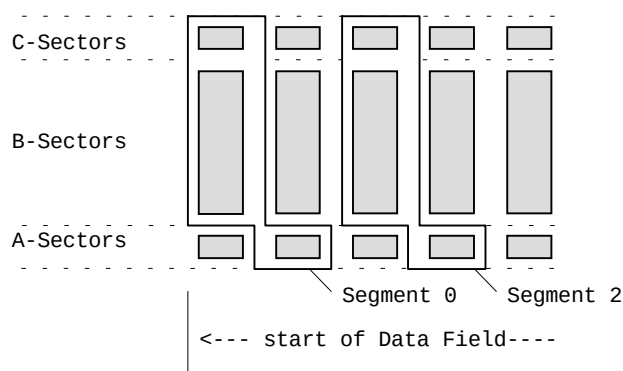


Figure 2 – Segment and sector counting (Example a)

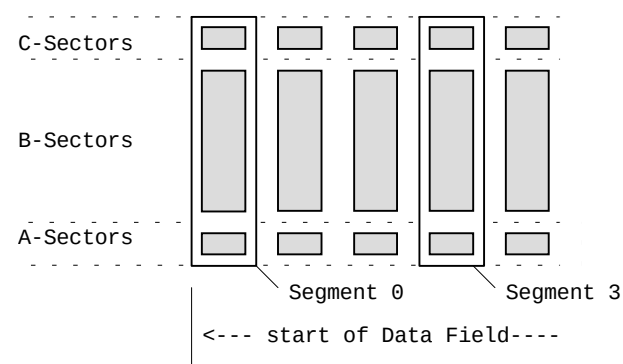


Figure 3 – Segment and sector counting (Example b)

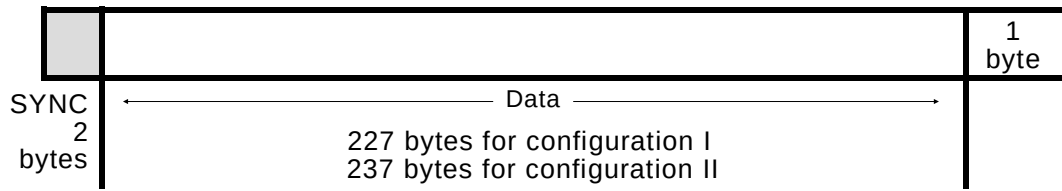


Figure 4 – Block structure in bytes

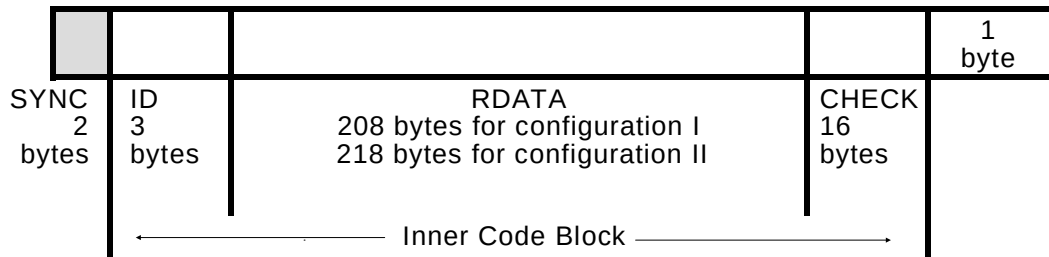


Figure 5 – Structure, in bytes, of the inner code block before channel modulation

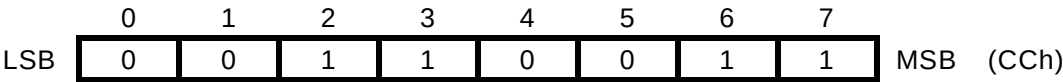


Figure 6 – One byte of run-up pattern before channel modulation

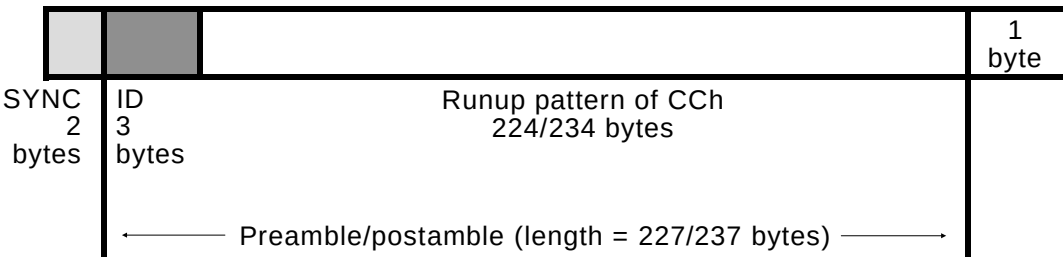
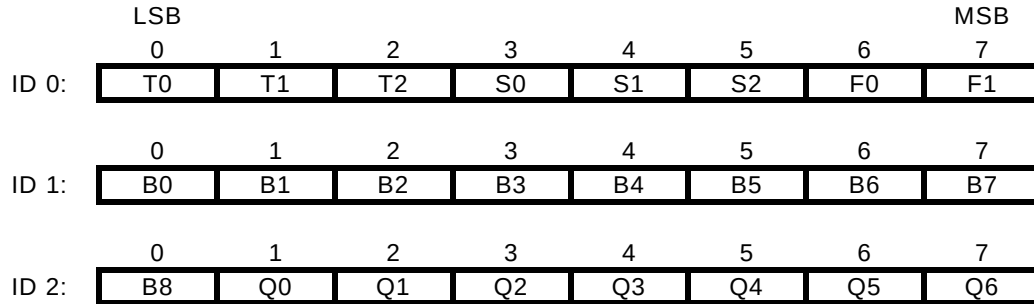


Figure 7 – Structure, in bytes, of preamble/postamble before channel modulation

**Figure 8 – ID information**

The three ID bytes are defined as follows:

- ID 0: T0 ... T2: Track identification (0 ... 7)
 S0 ... S2: Segment identification (0 ... 7)
 F0, F1: Data field identification (0 ... 3)
- ID 1: B0 ... B7: Block identification (eight bits)
- ID 2: B8: Block identification (ninth bit)
 Q0 ... Q6: Data or video standard dependent

6 Randomization

All data bytes and associated outer check bytes (see for example figure 11 of ANSI/SMPTE 278M) shall be randomized before being inserted into the inner code block and before calculation of the inner check bytes. Sync, IDs, inner check bytes, and the run-up patterns of the preamble and postamble are not randomized.

The randomization shall be performed by an exclusive-or (X-OR) operation of the data bytes and associated outer check bytes with the randomizing bytes commencing with the first byte location after the identification (ID) bytes. The result of the ex-oring are the RData bytes.

A randomizing sequence is formed by reading successive bytes from table 1. The sequence may commence at any address location in the table between 000_h and F0E_h and continue sequentially for 208/218 bytes.

The starting address of the randomizing sequence is defined by the ID words. The exact relation between starting address and ID words depends on the recorded video or data standard.

Table 1 – Randomization sequence

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
00	FF	D0	63	01	71	A4	03	93	EC	04	B5	35	0D	DF	5E	17
10	61	E3	39	A3	25	4A	E5	6E	DE	2F	B3	62	70	D5	A7	90
20	7F	E8	B1	80	38	D2	81	49	76	82	DA	9A	86	6F	AF	8B
30	B0	F1	9C	D1	12	A5	72	37	EF	97	59	31	B8	EA	53	C8
40	3F	F4	58	40	1C	E9	C0	24	3B	41	6D	4D	C3	B7	D7	45
50	D8	78	CE	68	89	52	B9	9B	F7	CB	AC	18	5C	F5	29	E4
60	1F	7A	2C	20	8E	74	60	92	9D	A0	B6	A6	E1	DB	EB	22
70	6C	3C	67	B4	44	A9	DC	CD	FB	65	56	0C	AE	FA	14	F2
80	0F	3D	16	10	47	3A	30	C9	4E	50	5B	D3	F0	ED	75	11
90	36	9E	33	5A	A2	54	EE	E6	FD	32	2B	06	57	7D	0A	F9
A0	87	1E	0B	88	23	1D	98	64	27	A8	AD	69	F8	F6	BA	08
B0	1B	CF	19	2D	51	2A	77	F3	7E	99	15	83	AB	3E	85	FC
C0	43	8F	05	C4	91	0E	4C	B2	13	D4	D6	34	7C	7B	5D	84
D0	8D	E7	8C	96	28	95	BB	79	BF	CC	8A	C1	55	9F	42	FE
E0	A1	C7	02	E2	48	07	26	D9	09	6A	6B	1A	BE	BD	2E	C2
F0	C6	73	46	4B	94	CA	DD	BC	5F	66	C5	E0	AA	4F	21	–

7 Modulation code

The blocks are subject to an 8–12 modulation coding prior to recording. Eight tables are used to map incoming data bytes to 12-bit words. The tables given in this standard are not valid for the sync which may be a unique sequence as described in ANSI/SMPTE 278M. The modulation tables are numbered A1 to A4 and B1 to B4. The table used depends on parameters Pa, Pb, Pc (see table 2).

For the preset byte of data:

Pa is true ("1") a) if no * is attached in the modulation table to the previous data, **OR** b) if the previous modulation bits are part of a sync.

Pb is true ("1") if the last bit of the previous modulation bits of data or sync equals "0."

Pc is true ("1") a) if the next modulation bits are not part of a sync, **AND** b) the first two bits of the next byte of data prior to modulation equal "10" (first bit written left).

Table 2 – Selection of modulation tables

	Pa	Pb	Pc
Modulation table A1	1	1	0
Modulation table A2	1	1	1
Modulation table A3	1	0	0
Modulation table A4	1	0	1
Modulation table B1	0	1	0
Modulation table B2	0	1	1
Modulation table B3	0	0	0
Modulation table B4	0	0	1

For the modulation tables, see clause 11. Recording starts with the left modulation bit leading. The unmodulated data are given in hexadecimal form with the left digit representing the four most significant bits of the byte of unmodulated data.

8 Magnetization

8.1 Polarity

The recorder shall operate in reproduce mode without regard to the polarity of the recorded flux on the helical tracks.

8.2 Record equalization

The record head current should generate the same flux levels at the head gap at both the Nyquist and half-Nyquist frequencies.

8.3 Record level

Record head current should be optimized for best reproduced signal-to-noise ratio at the highest constant recorded frequency (i.e., the Nyquist frequency of the channel). Other methods of setting the record level are permitted, providing they achieve equivalent results.

9 Longitudinal tracks

9.1 General

There are three longitudinal tracks as dimensionally specified in clause 10. These tracks carry the index, cue, and control records. This clause describes their electrical parameters.

9.2 Control track

9.2.1 Method of recording

The control track shall be recorded using the direct saturated (nonbiased) recording method.

9.2.2 Servo reference pulse doublet

The servo reference pulse at the time of recording shall be a series of pulse doublets with a pulse distance of 3.33 ms as shown in figure 9.

9.2.3 Flux polarity

During the time interval A (see figure 9) of the record, the polarity of the recorded flux shall be such that the south poles of the magnetic domains point in the direction of normal tape movement. During time B, the north poles shall be similarly oriented.

9.2.4 Flux level

The recorded current shall maximize the playback signal.