ANSI/SMPTE 6-1988
Revision and Redesignation of
ANSI V98.6-1981

American National Standard for video recording— video, audio and tracking-control records— 2-in quadruplex tape

Approved May 3, 1988 Sponsor: Society of Motion Picture and Television Engineers

1. Scope

This standard specifies both the locations for the edges of the video, audio, and tracking-control records, and the mechanical separation of the simultaneously-recorded information of the video and audio records, as recorded at 15 and 7.5 in/s on 2-in quadruplex video magnetic tape.

2. Referenced Document

This standard is intended for use in conjunction with the following SMPTE Recommended Practice:

SMPTE RP 16-1982, Specifications of Tracking Control Record for 2-in Quadruplex Video Magnetic Tape Recordings

3. Definitions

3.1 Transverse: Pertaining to dimensions or motions perpendicular to the tape travel.

3.2 Longitudinal: Pertaining to dimensions or motions parallel to the tape travel.

3.3 Downstream: Pertaining to locations on the tape longitudinally displaced from a given reference point, in the direction of tape travel.

3.4 Upstream: Pertaining to locations on the tape longitudinally displaced from a given reference point, in a direction opposite to tape travel.

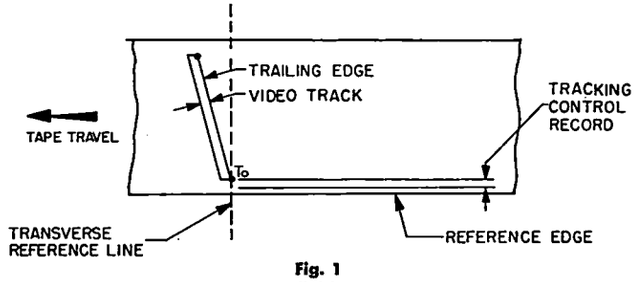


Fig. 1
Definitions

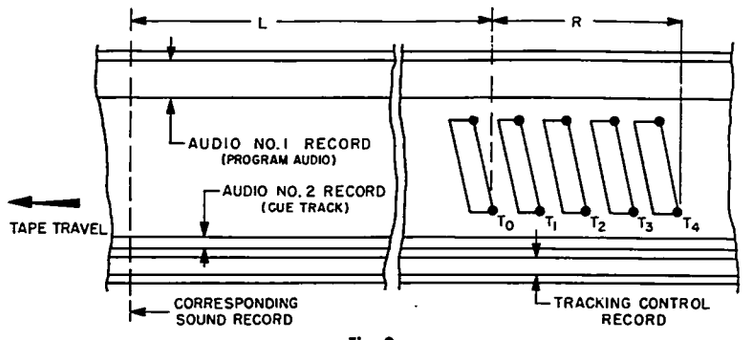


Fig. 2
Longitudinal Dimensions

3.5 Reference Edge: On a video tape containing quadruplex-recorded information, that longitudinal tape edge nearest the tracking-control record.

3.6 Trailing Edge, Video Track: The upstream edge of the video track.

3.7 Transverse Reference Line: A line perpendicular to the reference edge and passing through a video track trailing edge at its lowest end (point T_0) as in Fig. 1.

4. General

4.1 References. The transverse reference line and reference edge shall be the references for all dimensions in this standard.

4.2 Measurement Conditions. The dimensions specified in this standard are measured with no transverse or longitudinal tension applied to the tape. (See Appendix A4.)

4.3 Magnetic Coating. With the direction of tape travel as shown in all figures in this standard, the magnetic coating is on the surface facing the observer.

5. Longitudinal Dimensions

5.1 Average Video Track Pitch. For a tape recorded at 15 in/s (381 mm/s), the longitudinal distance, R, from a transverse reference line to a point, T_4, four tracks away (See Fig. 2), shall be greater than 0.062438 in (1.58593 mm) and less than 0.062562 in (1.58907 mm). (An acceptable method for obtaining the accuracy required by the above dimensions is to measure the span occupied by 3072 tracks, which should be greater than 47.952 in (1217.98 mm) and less than 48.048 in (1220.42 mm).) See Appendixes A2 and A3.

For a tape recorded at 7.5 in/s (190.5 mm/s), the longitudinal distance from a tranverse reference line to a point, T_4, four tracks away shall be greater than 0.031219 in (0.79296 mm) and less than 0.031281 in (0.79454 mm). (An acceptable method for obtaining the accuracy required by the above dimensions is to measure the span occupied by 3072 tracks, which should be greater than 23.976 in (608.99 mm) and less than 24.024 in (610.21 mm).) See Appendixes A2 and A3.

5.2 Video Track Spacing. The longitudinal distance from any transverse reference line to Points T_1, T_2, and T_3 shall be R/4, R/2, and 3R/4, respectively, with a tolerance of $\pm$ 0.00015 in (0.0038 mm), where R is the average video track pitch as determined in Section 5.1 for the tape being measured (See Fig. 2). (The tolerances indicated cannot be readily measured on a pre-recorded tape by methods presently available. At the present state of the art, these dimensions are controlled by the head wheel manufacturer's ability to achieve coplanarity of the recording pole tips.) See Appendixes A2 and A3.

5.3 Video Track Curvature and Angle. The trailing edge of any video track shall fall between two parallel lines spaced apart by 0.001 in (0.03 mm).

For a tape recorded at 15 in/s, the two parallel lines shall make, with the reference edge, a positive angle no greater than 90° 36′ and no less than 90° 30′, when positioned so as to enclose the entire length of the video track trailing edge.

For a tape recorded at 7.5 in/s, the two parallel lines shall make, with the reference edge, a positive angle no greater than 90° 19′ 30″ and no less than 90° 13′ 30″, when positioned so as to enclose the entire length of the video track trailing edge.

5.4 Video Track Width. For a tape recorded at 15 in/s, the longitudinal width of any video track shall lie between 0.0095 in (0.241 mm) and 0.0105 in (0.267 mm), measured at any and all points along its transverse direction. For a tape recorded at 7.5 in/s, the video track width shall lie between 0.0050 in (0.127 mm) and 0.0060 in (0.152 mm).

5.5 Audio Record Displacement. Audio or other information which is time-coincident with video information recorded at a point, T, of any video track shall be recorded in Audio Record No. 1 (Program Audio) or Audio Record No. 2 (Cue Track), at a distance, L, downstream from that point, T, where L shall be at least 9.200 in (233.68 mm) and no more than 9.300 in (236.22 mm).

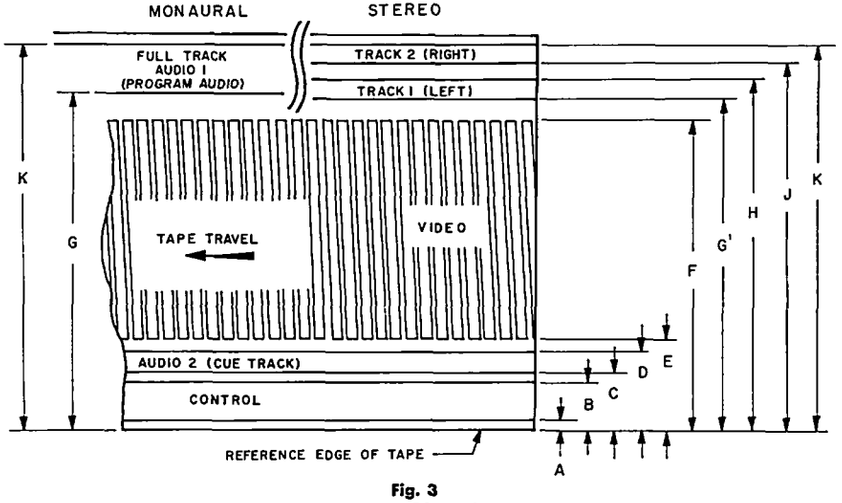


Fig. 3
Tranverse Dimensions

Dimensions	Inches		Millimeters	
	Min	Max	Min	Max
A	0.000	0.004	0.00	0.10
B	0.040	0.049	1.02	1.24
C	0.058	0.062	1.47	1.57
D	0.078	0.085	1.98	2.16
E	0.087	0.094	2.21	2.39
F	1.902	1.914	48.31	48.62
G	1.921	1.930	48.79	49.02
G′	1.920	1.928	48.77	48.97
H	1.945	1.951	49.40	49.56
J	1.965	1.971	49.91	50.06
K	1.988	1.996	50.50	50.70

6. Transverse Dimensions

The transverse dimensions shall be as specified in Fig. 3 and the table.

7. Program Audio (See Fig. 3)

7.1 Monaural Recording Mode. The usual method for recording a monaural audio program shall be by means of a recording head producing an Audio 1 pattern of dimensions G-K (full track).

7.2 Stereo Recording Mode. Recording of stereo shall be by means of a split recording head producing an Audio 1 pattern of dimensions G′-H for Track 1 (left) and J-K for Track 2 (right).

7.2.1 Program Audio Head Position. In addition to the required dimensions for the mechanical separation of the simultaneously-recorded information of the video and audio records (see 5.5), the record/reproducer gaps of the two stereo program audio heads shall lie on a common straight line.

7.2.2 Relative Polarity. For stereo program material, the relative polarity of the audio signals at the inputs to a stereo television magnetic tape recorder shall be such that any monophonic component of the program shall have the same polarity in the magnetic records of both channels.

7.2.3 Monaural Program (While in Stereo Mode). If there is to be only one audio program recorded by a machine with the stereo recording track record (of 7.2), then both Tracks 1 and 2 shall be utilized for that single program.

Appendix

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

A1. A magnetic record is that area in which magnetization conveying the intended signal exists. A common technique for measurement of record locations and dimensions is the use of carbonyl iron to make them visible.

A2. Since all recorded tapes exhibit wow and flutter to some degree, the span of measured tracks should be long enough to average out variations in video track pitch arising from wow or flutter. If other measuring methods are employed, appropriate averaging must be included in the measurement.

A3. The track pattern specified by Sections 5.1 and 5.2 results when the tape speed in inches per second and the head wheel rotational rate in revolutions per second are in the ratio of 0.0625:1 for 15 in/s recording practice, and in the ratio of 0.03125:1 for 7.5 in/s recording practice. Since both the head wheel rotational speed and the capstan metering rate are locked to the television frame rate, the speed of the tape will vary with the television frame rate. This speed variation will not alter the pattern placed on the tape. Replay rate of any recording, as well as the replay rate of the information contained in the record, will be determined solely by the reference frequency to which the replay capstan and head wheel are synchronized.

Primary causes of departures from the video track pitch specified by Section 5.1 are incorrect capstan diameter, capstan slippage, or incorrect longitudinal tape stretch.

The tolerances specified in Section 5.1 reflect the magnitude of allowable changes in the ratio of tape speed to head wheel rotational speed. Variations in excess of those specified will not only result in improper video track pitch but will also result in an incorrectly placed control track on tapes recorded on machines having the control track head displaced from the plane of rotation of the video pole tips by approximately 0.7 in (18 mm), as is common practice in present-day transports. (See SMPTE RP 16-1982 for a description of the tracking-control record.)

A4. Although, with sufficient care, measurements of track dimensions may be made with no transverse or longitudinal tension applied to the tape, tape-handling problems during measurements may be lessened by making two sets of measurements at two different longitudinal tensions and extrapolating data thus obtained to the zero-tension condition.

A5. Current technology restricts the application of this standard to those applications, such as stereo, which can tolerate a moderate amount of crosstalk between channels or tracks.

ANSI/SMPTE 242-1988
Revision and Redesignation of
ANSI PH22.35-1982

American National Standard
for motion-picture equipment (35-mm)— universal intermittent sprockets

Approved May 3, 1988 Sponsor: Society of Motion Picture and Television Engineers

1. Scope

1.1 This standard specifies the dimensions of two types of 16-tooth intermittent sprockets for 35-mm motion-picture projectors. Other dimensions and definitions are given in the Appendix.

1.2 This standard is applicable to sprockets used in conjunction with film perforated in accordance with ANSI/SMPTE 139-1986 (0.1870 in pitch), or ANSI/SMPTE 102-1986.

2. Referenced American National Standards

This standard is intended for use in conjunction with the following American National Standards:

ANSI/SMPTE 102-1986, Motion-Picture Film (35-mm)—Perforated CS-1870

ANSI/SMPTE 139-1986, Motion-Picture Film (35-mm)—Perforated KS

3. Sprocket Tooth Types

3.1 Type S is the standard square tooth that is used internationally and known as the CS sprocket tooth.

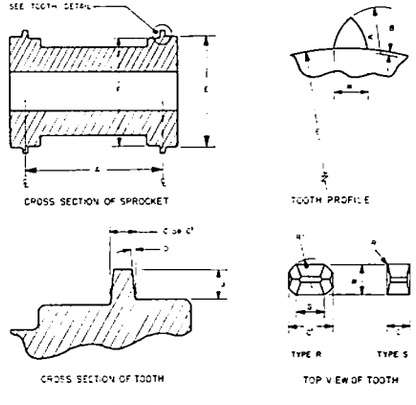
3.2 Type R is the round tooth that eliminates sharp corners on film contacting surfaces.

4. Dimensions

4.1 The dimensions shall be as specified in the figures and table.

4.2 The sprocket tooth pitch is measured at the midpoint of 0.006 in (0.15 mm) film thickness:

$$\frac{(\text{Diameter E} + 0.006\text{ in})\,\pi}{\text{Number of Teeth}}$$



American National Standards Institute, 1430 Broadway, New York, N.Y. 10018

	Dimensions	Inches	Millimeters
A	Tooth centerline to centerline	1.125 ± 0.001	28.58 ± 0.03
B	Center point of tooth arc	0.004 — 0.001	0.10 — 0.03
C	Square tooth lateral width	0.040 $^{+\ 0.001}_{-\ 0.002}$	1.02 $^{+\ 0.03}_{-\ 0.05}$
C′	Round tooth lateral width	0.072 — 0.002	1.83 — 0.05
D	Lead angle at tooth sides	7°30′ max	
E	Root (film supporting) diameter	0.950 ± 0.001	24.13 ± 0.03
F	Inner diameter	0.010 less than E	0.25 less than E
G	Bearing surface	0.046 — 0.002	1.17 — 0.05
J	Tooth height above E	0.050	1.27
K	Tooth arc	0.077 + 0.002	1.96 + 0.05
R	Square tooth corner radius	0.005 max	0.13 max
R′	Round tooth corner radius	0.043 ± 0.001	1.09 ± 0.03
W	Horizontal tooth width	0.055 — 0.002	1.40 — 0.05

Appendix

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

A1. The figures describe the tooth shapes which recognize the following factors: (1) smooth disengagement of sprocket teeth and transfer of driving forces from perforation to perforation; (2) shrinkage and dimensional changes in motion-picture film; and (3) elastic deformation of the perforation edge induced by the drive forces on the perforation edge.

A2. In current practice, the upper sprocket is usually a feed sprocket while the lower sprocket may function as a holdback sprocket or simply as an idler. These sprockets have dimensional values identical to those shown in the table except for root diameter E. Diameter E is nominally 0.943 in (23.95 mm) on a 16-tooth feed sprocket or 0.940 in (23.88 mm) on those serving as holdback sprockets. 24-tooth feed sprockets have E diameters ranging from 1.413 to 1.424 in (35.89 to 36.17 mm) and holdback sprockets are nominally 1.413 in (35.89 mm) with some variation from manufacturer to manufacturer.

A3. As stated in Sec. 1.2, this standard specifies sprockets designed to accommodate films with either KS or CS perforations which have different specifications insofar as perforation size and positioning are concerned. This requirement affects the centerline-to-centerline dimension (A) and the tooth width (C). The tooth width specified in the table as Dimension C (square tooth) is the dimension covered by the former standard, PH22.35-1962. The value specified for C′ (round tooth) is an alternative design permitting a greater tooth width and a relatively large break at each tooth corner which avoids contact of the tooth corner with the fillet radii in the perforation corners, thus limiting the possibility of the tooth damaging the film. Elimination of square tooth corners also minimizes abrasion of the perforation edge. In special instances where a projector is to be used only with films having one type of perforation, it may be advantageous to use sprockets made specifically for that type of perforation. For example, projectors to be used only with films having CS perforations might have a tooth centerline-to-centerline dimension (A) at 1.125 in (28.58 mm) and a tooth width dimension (C) of 0.048 in (1.22 mm) maximum driving face. A projector intended only for use with films having KS perforations might have sprockets with a tooth centerline-to-centerline at 1.109 in (28.17 mm) and a tooth width of 0.065 in (1.65 mm) maximum driving face.

A4. Definitions:

Feed Sprocket. A feed sprocket is used to advance the film against a restraining force. The force is applied to the leading edge of the film perforation (viewed in the direction of film motion). The sprocket rotates at a nominally constant velocity and tends to keep the film in motion. It is also called an advancing or drive sprocket and is usually lightly loaded.

Intermittent Sprocket. An intermittent sprocket is a feed sprocket used to advance the film periodically (frame by frame). The sprocket is usually completely at rest during the intervals between advances. It is normally heavily loaded during a portion of its motion since it must accelerate the film from zero velocity and achieve an average rate of film advance. The root diameter is usually larger than that of a feed sprocket because of greater perforation distortion.

Holdback Sprocket. The holdback sprocket is used to restrain the film against a tension force. The force is applied to the trailing edge of the film perforation (viewed in the direction of film motion) and the sprocket rotates at a nominally constant velocity. It is also called a retarding or restraining sprocket.