tions, and leaders in national and international standardization. Question and answer periods will afford ample opportunity for discussion with the panelists.

Details of the ISO General Assembly are provided in the program, which includes a registration form. Admission is free and accommodations at the Sheraton-Park Hotel in Washington, D.C., headquarters for the meeting, may be reserved through ANSI, 1430 Broadway, New York, NY 10018.

standards and recommended practices

Approved American National Standards

On 12 June 1973, the American National Standards Institute approved three standards in the videotape recording field: C98.3-1973, Frequency Response and Operating Level of Recorders and Reproducers for Audio Record One for 2-inch Quadruplex Video Magnetic Tape Operating at 15 and 7.5 in/s; C98.6-1973, Dimensions of Video, Audio and Tracking Control Records on 2-inch Video Magnetic Tape Quadruplex Recorded at 15 and 7.5 in/s; and C98.8-1973, Specifications for an Audio Level and Multifrequency Test Tape for Quadruplex Video Magnetic Tape Recorders Operating at 15 in/s.

Although it is a substantial revision of the 1970 issue, the technical content of C98.3 is unchanged. The frequency response was previously given in terms of a "standard system" having an "ideal" reproducing head followed by an RC equalizing network. The committee decided that it is more accurate to specify the system response in terms of the basic physical quantity of the recorded signal, i.e., the "shortcircuit tape flux."

C98.6 is basically an editorial revision of the 1965 issue. It does not reflect a technical change but has been rewritten to facilitate its use and more accurately specify the important parameters.

C98.8 has been revised in terms of the shortcircuit flux method and does not base its calibration on a primary reference level recording.

Inasmuch as compliance with American National Standards is purely voluntary, these standards will become truly effective when broad publicity is given to their existence. ANSI and SMPTE would appreciate any personal influence to promote the use of this standard where such action is appropriate. Copies of these standards may be obtained for a nominal fee from the American National Standards Institute, 1430 Broadway, New York, NY 10018.

Draft American National Standards

Two Draft American National Standards are published here for a trial period and public review.

PH22.159.5, Specifications for Camera Run Length, Perforation Cut-Out and End-of-Run Notches in Super 8 Motion-Picture Film Model I Camera Cartridges (50-Ft, 15-Meter Capacity), is a revision of the 1968 issue differing only by the addition of specifications for the end-of-run notch.

PH22.187, Dimensions for Projection Lamps, Condenser-Reflector, Four-Pin, Prefocus-Base, is a new standard specifying dimensions for internal-reflector, four-pin projection lamps.

Comments should be addressed to Alex E. Alden, Staff Engineer, at Society Headquarters prior to 1 November 1973. The proposals have been submitted to American National Standards Committee PH22. All comments received through *Journal* publication will be reviewed before conclusion of action by that Committee. — Alex E. Alden, *Staff Engineer*

ANSI C98.3-1973
Revision of C98.3-1970

American National Standard
frequency response and operating level of recorders and reproducers for audio record one for 2-inch quadruplex video magnetic tape operating at 15 and 7.5 in/s

Approved June 12, 1973 — Secretariat: Society of Motion Picture and Television Engineers, Inc.

Page 1 of 3 pages

1. Scope

This standard specifies the frequency response and operating level for recorders and reproducers for Audio Record One for 2-inch quadruplex video magnetic tape recording at 15 and 7.5 in/s (380 and 190 mm/s), as defined in American National Standard Dimensions of Video, Audio and Tracking Control Records on 2-inch Video Magnetic Tape Quadruplex Recorded at 15 and 7.5 in/s, C98.6-1973. It also specifies the field method of calibration of recorders and reproducers, utilizing the test tapes, as defined in American National Standard Specifications for an Audio Level and Multifrequency Test Tape for Quadruplex Video Magnetic Tape Recorders Operating at 15 in/s, C98.8-1973, and Draft American National Standard Specifications for an Audio Level and Multifrequency Test Tape for Quadruplex Video Magnetic Tape Recorders Operating at 7.5 in/s, C98.11.

2. Operating Level

2.1 Recording and Reproducing Level Indicator. The audio recording and reproducing levels of a video magnetic tape recorder shall be monitored and adjusted with a standard volume indicator (vu meter), as specified in American National Standard Volume Measurements of Electrical Speech and Program Waves, C16.5-1961 (R-1954).

2.2 Recorder Operating Level. When a tape record is recorded from a sinusoidal voltage having a frequency of 1000 Hz, such that the rms shortcircuit tape flux per unit track width on the record is 110 = 3 nanowebers per meter of track width, the recording volume indicator shall be adjusted to deflect to its reference level (0 dB) scale mark.

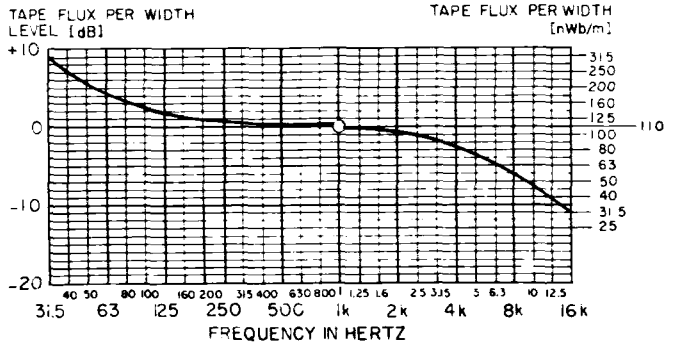
2.3 Reproducer Operating Level. When a tape record having an rms sinusoidal flux per width of 110 nWb/m and a frequency of 1000 Hz is reproduced, the reproducing volume indicator shall deflect to its reference level (0 dB) scale mark.

3. Frequency Response

3.1 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 shortcircuit tape flux level on the record versus frequency, $L_\Phi(f)$, shall be as given by the following equation:

$$L_\Phi(f) = 10 \log_{10} \{[1 + (F_r/2)^2]/[1 + (f/F_n)^2]\} \text{ [dB]}$$

where f is the frequency at which the response is being computed; F_r is the low-frequency transition frequency, 80 Hz; and F_n is the high-frequency transition frequency, 4500 Hz. A graph of this equation is shown in the figure.



Flux and Flux Level vs Frequency

3.2 Reproducer Flux/Frequency Response. When a tape record having a shortcircuit tape flux level versus frequency given in Sec. 3.1 is reproduced, the output voltage level of the reproducer versus frequency shall be constant.

4. Field Method of Calibrating Recorders and Reproducers

4.1 The practical calibration of a reproducer shall be performed by reproducing the Audio Level and Multifrequency Test Tape defined in American National Standard Specifications for an Audio Level and Multifrequency Test Tape for Quadruplex Video Magnetic Tape Recorders Operating at 15 in/s, C98.8-1973, or Draft American National Standard Specifications for an Audio Level and Multifrequency Test Tape for Quadruplex Video Magnetic Tape Recorders Operating at 7.5 in/s, C98.11. The practical calibration of a recorder shall then be performed by recording on a medium representative of that to be used, and comparing the recording so made with the recording on the test tape.

4.2 The flux/frequency response of a reproducer shall be calibrated by reproducing the Frequency Response Test Section of the specified test tape. The reproducing equalizer is adjusted so that output voltage level versus frequency of the reproducer is constant.

4.3 The operating level of a reproducer shall be calibrated by reproducing the Audio Operating Level Test Section of the specified test tape. The reproducing gain control is adjusted so that the reproducing volume indicator deflects to its reference level (0 dB) scale mark.

4.4 The flux/frequency response of a recorder shall be calibrated by comparing the tape flux recorded by the recorder (with constant input voltage level), to the flux recorded on the Frequency Response Test Section of the specified test tape. The recording equalizer is adjusted so that the tape flux level versus frequency of a recorder (including the tape) is the same as that on the test tape.

4.5 The operating level of a recorder shall be calibrated by comparing the tape flux recorded by the recorder when the recording volume indicator deflects to its reference level (0 dB) scale mark, to the recording of the Audio Operating Level Test Section of the specified test tape. The recording gain control is adjusted so that, when the recording volume indicator deflects to its reference level (0 dB) scale mark, the recorded tape flux is the same as that on the test tape.

Appendix

(The Appendix is not a part of this American National Standard, but is included for information purposes only.)

A1. Although stated in a different way, the flux specified in Sec. 2.2 is the same as that previously standardized in American National Standard Specifications for a Primary Audio Reference Level Recording for Quadruplex Video Magnetic Tape Recorders Operating at 15 in/s, C98.7-1969, and American National Standard Specifications for a Primary Audio Reference Level Recording for Quadruplex Video Magnetic Tape Recorders Operating at 7.5 in/s, C98.10-1969, which are being revised and consolidated into other American National Standards.

The flux/frequency response given in Sec. 3.1 is the same as that standardized in American National Standard Electrical Characteristics of Audio Record One for 2-in Quadruplex Video Magnetic Tape Recording at 15 and 7.5 in/s, C98.3-1970.

A2. Previous frequency response standards for recorders and reproducers have been given in terms of a "standard reproducing system," having an "ideal" reproducing head followed by a standardized RC equalizing network whose time constant was given.

Because an adequate description of the "ideal" head and its interconnection to the following network is quite lengthy, it is simpler to specify the system responses in terms of the basic physical quantity for the recorded signal, the "shortcircuit tape flux." The concepts are explained in detail by J. G. McKnight in the paper "Flux and flux-frequency measurements and standardization in magnetic recording," J. SMPTE, 78: 457-472, June 1969.

Rather than specifying flux/frequency response in terms of admittances of electrical networks, the equation and graph of the response function have been specifically given. This equation does in fact describe the response of the previously specified RC equalizing network with "time constants" of 2000 and 35 microseconds.

American National Standard

dimensions of video, audio and tracking control records on 2-inch video magnetic tape quadruplex recorded at 15 and 7.5 in/s

Approved June 12, 1973 Secretariat: Society of Motion Picture and Television Engineers, Inc.

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 on 2-in quadruplex video magnetic tape.

2. Definitions

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

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

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

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

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

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

2.7 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 Figure 1.

3. General

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

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

3.3 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.

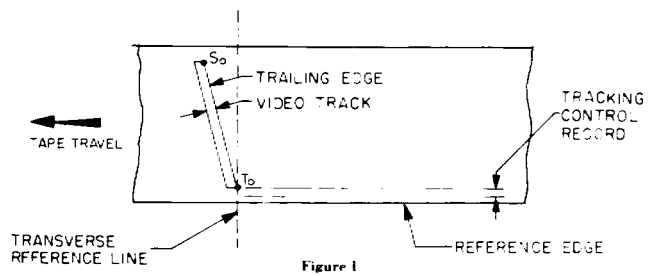


Figure 1
Definitions

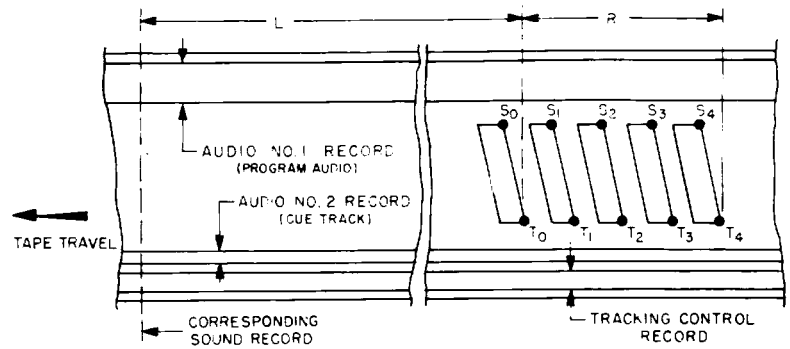


Figure 2
Longitudinal Dimensions

4. Longitudinal Dimensions

4.1 Average Video Track Pitch. For a tape recorded at 15 in/s (380 mm/s), the longitudinal distance, R, from a transverse reference line to a point, T_4, four tracks away (See Figure 2), shall be greater than 0.062438 in (1.58592 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 mm/s), the longitudinal distance from a transverse reference line to a point, T_4, four tracks away shall be greater than 0.031219 in (0.792962 mm) and less than 0.031281 in (0.794537 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.

4.2 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 ± 0.00015 in (0.0038 mm), where R is the average video track pitch as determined in Section 4.1 for the tape being measured (See Figure 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.

4.3 Video Track Curvature and Angle. The trailing edge of any video track shall fall between two parallel lines spaced apart by 0.001 in (0.025 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.

4.4 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 0.0045 in (0.114 mm) and 0.0055 in (0.140 mm).

4.5 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).

5. Transverse Dimensions

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

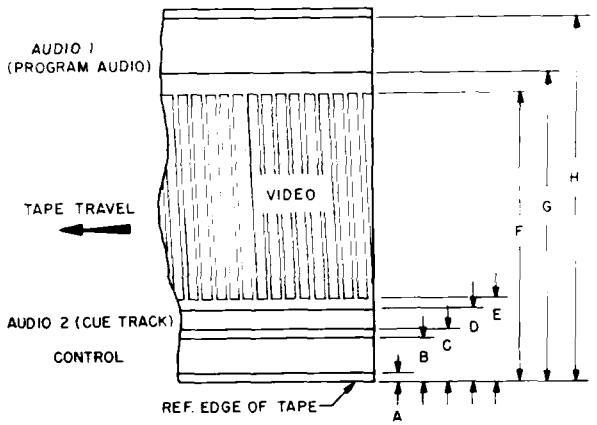


Figure 3
Transverse Dimensions

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
H	1.988	1.996	50.50	50.70

Appendix

(The Appendix is not a part of this American National Standard, but is included for information purposes 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 4.1 and 4.2 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 4.1 are incorrect capstan diameter, capstan slippage, or incorrect longitudinal tape stretch.

The tolerances specified in Section 4.1 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 Recommended Practice RP 16-1970, Specifications of Tracking Control Record for 2-in Quadruplex Video Magnetic Tape Recordings, 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.

ANSI C98.8-1973
Revision of C98.7-1969 and C98.8-1969

American National Standard

specifications for an audio level and multifrequency test tape for quadruplex video magnetic tape recorders operating at 15 in/s

Approved June 12, 1973

Secretariat: Society of Motion Picture and Television Engineers, Inc.

1. Scope

This standard specifies an audio frequency test tape to be used for adjusting the sensitivity and the frequency response of the audio reproducing system of quadruplex video magnetic tape recorders operating at a tape speed of 15 in/s (380 mm/s), in accordance with American National Standard Frequency Response and Operating Level of Recorders and Reproducers for Audio Record One for 2-inch Quadruplex Video Magnetic Tape Operating at 15 and 7.5 in/s, C98.3-1973.

2. General Specifications

2.1 Dimensions of Records. The dimensions of pertinent records constituting this test tape shall conform to American National Standard Dimensions of Video, Audio and Tracking Control Records on 2-inch Video Magnetic Tape Quadruplex Recorded at 15 and 7.5 in/s, C98.6-1973.

2.2 Tape Speed. The nominal linear speed of this test tape shall be 15 in/s in accordance with American National Standard Speed of 2-inch Tape for Quadruplex Video Magnetic Tape Recording, C98.4-1970.

2.3 Stock. The test sections shall be recorded on transversely-oriented television magnetic recording tape, the dimensions of which are specified in American National Standard Dimensions of 2-inch Video Magnetic Tape, C98.1-1969 (R-1963).

2.4 Video Signal. No video signal of any kind shall be recorded.

2.5 Tracking Control Signal. A tracking control signal, conforming to that specified in SMPTE Recommended Practice on Specifications of Tracking Control Record for 2-inch Quadruplex Video Magnetic Tape Recordings, RP 16-1970, as applicable, shall be recorded throughout the tape.

2.6 Test sections shall be recorded on Audio Record No. 1.

2.7 Voice announcement at the beginning of this tape shall provide identification as to the applicable American National Standard and test tape manufacturer. Each test section and segment shall be preceded by voice announcements identifying the content. Voice announcements shall be recorded at a level approximately 5 dB below operating level. (See 3.1 below.)

2.8 Weighted Peak Flutter. The weighted peak flutter of this test tape shall not exceed 0.2 percent.

3. Test Sections

3.1 SMPTE Quadruplex Audio Operating Level Test. This section is used to calibrate the sensitivity of an audio reproducing system.

3.1.1 Frequency. The frequency of the recording shall be 1000 Hz ±2 percent when the tape is reproduced at exactly 15 in/s.

3.1.2 Tape Flux Per Unit Width. The SMPTE Quadruplex Audio Operating Level Test recording has an rms shortcircuit tape flux per unit track width of 110 ± 3 nanowebers per meter of track width. (110 nWb/m corresponds to 110 pWb/mm, and 11 mMx/mm.)

3.1.3 Flux Level Variation. The flux level variation during the length of the tone shall fall within an envelope whose total width is 0.5 dB.

3.1.4 Distortion. The total harmonic distortion of this section, when reproduced, shall not exceed 2 percent.

3.1.5 Duration. The minimum duration of this section shall be one minute.

3.2 Frequency Response Test. This section is to be used to calibrate the frequency response of the audio reproducing system of a video magnetic tape recorder.

3.2.1 Frequencies. The following test segment frequencies (in hertz) shall be recorded in the order given.

1000 (reference) / 63 / 125 / 250 / 500 / 1000 / 2000 / 4000 / 8000 / 10 000 / 12 500 / 16 000 / 1000 (reference)

The frequency of each recording shall be ± 2 percent of its specified value when the tape is reproduced at exactly 15 in/s.

3.2.2 Tape Flux Level vs Frequency. The shortcircuit tape flux level versus frequency shall be as given by the following equation:

$$L_\Phi(f) \text{ re } 110\,\text{nWb/m} = 0.2 - 10\log_{10}\left\{[1 + (F_1/f)^2]/[1 + (f/F_n)^2]\right\}\,[\text{dB}]$$

where f is the frequency at which the response is being computed; F_1 is the low-frequency transition frequency, 80 Hz; and F_n is the high-frequency transition frequency, 4500 Hz. A graph of this equation is shown in the figure. A table of values of the tape flux and flux level is also given.

3.2.3 Flux Level Variation. The tape flux level at each frequency shall be within ± 0.5 dB of the value specified in Sec. 3.2.2. The tolerance of ± 0.5 dB may be extended to ± 2 dB provided that a calibration chart is supplied with the test tape by the manufacturer. The calibration figures furnished with the test tape shall represent the levels to be added algebraically to the reproducer output level when the particular test tape is reproduced. With the addition of these factors, the output level of the reproducer will be that which would have resulted if the test tape flux vs frequency had been exactly as specified in Sec. 3.2.2.

3.2.4 Duration. The duration of frequency response test segments shall be approximately ten seconds.

3.3 Azimuth. The tape flux shall be parallel to the reference edge of the tape with an azimuth alignment error not to exceed ± 0.9 milliradians (= 3 minutes of angle).

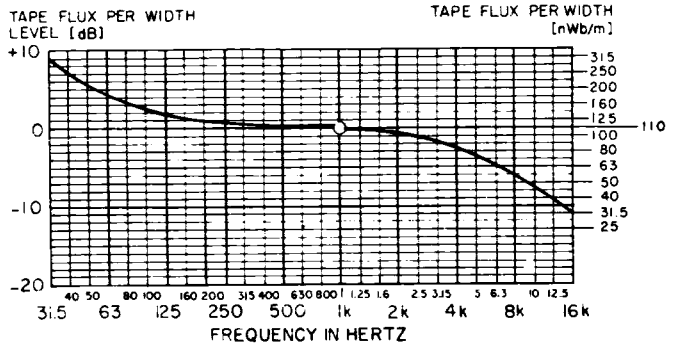
4. Calibration

4.1 Calibration of Tape Flux. The shortcircuit tape flux on the test tape shall be determined by means of the calibrated short-gap ferromagnetic core reproducer technique. This technique is described in the following references:

American National Standard Method of Measuring Recorded Flux of Magnetic Sound Records at Medium Wavelengths, S4.6-1973.

J. G. McKnight, "Flux and flux-frequency response measurements and standardization in magnetic recording," J. SMPTE, 78: 457-472, June 1969.

R. C. Lovick, R. E. Bartow and R. F. Scheg, "Recording and calibration of super-8 magnetic reproducer test films," J. SMPTE, 78: 473-481, June 1969.



Flux and Flux Level vs Frequency

FLUX AND FLUX LEVEL VERSUS FREQUENCY

Frequency Hz	Flux Per Width nWb/m	Relative Level dB
31.5	306	+8.9
40	252	+7.2
50	212	+5.7
63	181	+4.3
80	159	+3.2
100	144	+2.3
125	133	+1.7
160	126	+1.2
200	121	−0.8
250	118	+0.6
315	116	+0.4
400	114	+0.3
500	113	+0.2
630	112	+0.2
800	111	+0.1
1000	110	+0.0
1250	108	−0.1
1600	106	−0.3
2000	103	−0.6
2500	98.2	−1.0
3150	92.0	−1.6
4000	84.2	−2.3
5000	75.1	−3.3
6300	65.2	−4.5
8000	55.4	−6.0
10 000	46.1	−7.6
12 500	37.8	−9.3
16 000	30.7	−11.1

Flux and flux level versus frequency calculated at "preferred frequencies" using the equation given in Sec. 3.2.2.

4.2 Flux Level Variation Measurements. All flux level variations shall be measured with a meter or graphic level recorder which has a full-wave rectified average measurement law and the dynamics of the standard volume indicator (vu meter), as specified in American National Standard Volume Measurements of Electrical Speech and Program Waves, C16.5-1961 (R-1954).

4.3 Weighted Peak Flutter Measurement. Weighted peak flutter shall be measured in accordance with American National Standard Method of Measurement for Weighted Peak Flutter of Sound Recording and Reproducing Equipment, S4.3-1972.

Appendix

(The Appendix is not a part of this American National Standard, but is included for information purposes only.)

A1. A guide to proper usage and an explanation of the calibration techniques should be supplied with each test tape.

A2. Although stated in a different way, the flux specified in Sec. 3.1.2 is the same as previously standardized in American National Standard Specifications for a Primary Audio Reference Level Recording for Quadruplex Video Magnetic Tape Recorders Operating at 15 in/s, C98.7-1969, and the flux/frequency response given in Sec. 3.2.2 is the same as that standardized in American National Standard Electrical Characteristics of Audio Record One for 2-in Quadruplex Video Magnetic Tape Recording at 15 and 7.5 in/s, C98.3-1970.

Draft American National Standard

Specifications for Camera Run Length, Perforation Cut-Out and End-of-Run Notches in Super 8 Motion-Picture Film Model I Camera Cartridges (50-Ft, 15-Meter Capacity)

PH22.159.5

Revision of
PH22.159.5-1968

1. Scope

1.1 This standard describes the camera run length of film supplied in a super 8 motion-picture film Model I camera cartridge of 50-ft (15-meter) nominal capacity and the length of film returned to the customer. Its purpose is to provide a uniform basis for the operation of footage counters in cameras.

1.2 This standard also specifies the dimensions and location of a perforation cut-out notch and a notch in the unperforated side of super 8 camera films which may be used to indicate automatically the end of run.

2. Specifications

2.1 Camera Run Length

2.1.1 The camera run length of film may vary between 3666 perforation pitches (15.5 m or 50.9 ft) and 3710 perforation pitches (15.7 m or 51.5 ft). (See Notes 1 and 2.) The overall length of the film is to be determined by the manufacturer to provide the camera run length specified.

2.1.2 A complete film as returned to the customer shall contain a minimum customer return length of 3600 perforation pitches. The customer return length shall be that portion of the camera run length available for subject matter which starts at least 13 performation pitches (55 mm or 2.2 inches) after the frame which forms the camera aperture, as the cartridge is supplied by the manufacturer, and ends at least 37 perforation pitches (157 mm or 6.2 inches) short of the final frame of the camera run length limited by the perforation cut-out.

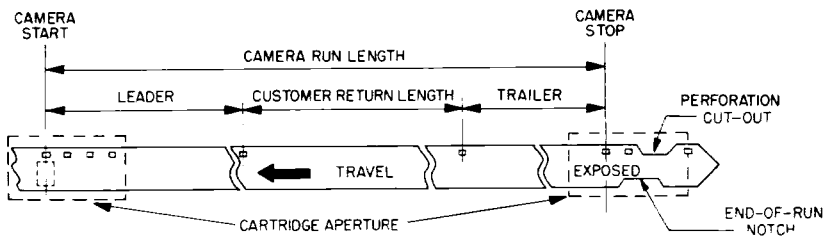


Figure 1
Camera Run Length and Notches

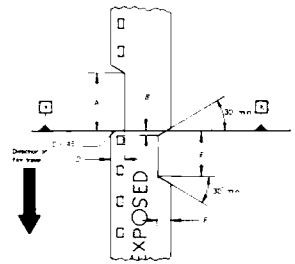


Figure 2
Notch Dimensions

Dimensions	Millimeters*	Inches
A†	5.38 min	0.212 min
B‡	0.3 max	0.012 max
C	0.55 max	0.022 max
D	1.50 min	0.059 min
E	4.52 ± 0.50	0.178 ± 0.020
F	0.80 min	0.031 min

*Metric units are primary.
†See 2.2.2.
‡See 2.2.6.

2.1.3 The end of the film shall have a visual marking in the frame area, and the perforations shall be cut out so that the final portion of the film stops in the film cartridge aperture providing the user with visual confirmation that all the film has been exposed.

2.2 Perforation Cut-Out and End-of-Run Notches

2.2.1 The dimensions shall be as given in Figure 2 and the table.

2.2.2 Datum Line X is established by the leading edge of the perforation cut-out, and must not cut through or interrupt a perforation. It is nominally perpendicular to the edge of the film.

2.2.3 The beveled cut at the trailing end of the perforation cut-out is shown as a matter of convenience and not as a specification. Some bevel is desirable, however, to reduce the possibility of catching or snagging the edge of the notch in the internal mechanism of the cartridge.

2.2.4 The beveled cuts of 30 degrees minimum at the ends of the end-of-run notch are to facilitate the entry of the camera sensing finger and to reduce the possibility of catching or snagging the edge of the notch in the internal mechanism of the cartridge.

2.2.5 The inside and outside corners of the notches may have a radius of 0.3 mm (0.01 inch) maximum.

2.2.6 Dimension B for the end-of-run notch shown in Figure 2 is expressed as a maximum to ensure a minimum notch length. There is no functional need to specify a maximum notch length. The trailing edge of the notch, specified by Dimension B, may approach or cross Datum Line X so that the notch length could extend to the end of the film provided the notch depth, Dimension F, is maintained.

NOTE 1: A nominal pitch, based on 72 perforation pitches per foot, of 4.234 mm (0.1667 inch) is assumed for all comparisons of the number of perforation pitches in a given film length. This assumption is based on American National Standard Dimensions for 8 mm Motion-Picture Film, Perforated Super 8, IR-1667, PH22.149-1967.

NOTE 2: The sum of the minimum customer return length (3600 perforation pitches), leader (13 perforation pitches), and trailer (37 perforation pitches) is intentionally less than the minimum camera run length (3666 perforation pitches). The 16 perforation pitch difference represents a tolerance for the film processor in unloading the cartridge, making processing machine splices, and the like.

NOTE 3: In addition to this standard, there are available the following American National Standards relating to super 8 film Model I camera cartridges:

PH22.159.1-1968, Specifications for Super 8 Motion-Picture Film Camera Cartridge and Cartridge-Camera Fit.

PH22.159.2-1968, Specifications for Cartridge Aperture and Pressure Pad and Position of Film in the Super 8 Motion-Picture Film Camera Cartridge

PH22.159.3-1968, Specifications for Super 8 Motion-Picture Film Camera Cartridge Pressure Pad Flatness and Camera Aperture Profile

PH22.159.4-1968, Dimensions and Characteristics of the Take-Up Core Drive for Super 8 Motion-Picture Film Camera Cartridges

PH22.166-1970, Specifications for Super 8 Motion-Picture Film Camera Cartridge Notches for Exposure Control and Stock Identification

Appendix

(The Appendix is not a part of this American National Standard, but is included for information purposes only.)

A1. The length of the leader and trailer are necessary to ensure that the fog produced near the aperture is removed. The material removed also provides space for identification numbers and allows for manufacturing variability of film length.

A2. The dimensional specifications of the end-of-run notch have been established to allow use of the cut-out designated by Dimensions M and N in the upper half of the cartridge pressure plate, as specified in American National Standard PH22.159.2-1968.

Draft American National Standard

Dimensions for Projection Lamps, Condenser-Reflector, Four-Pin, Prefocus-Base

PH22.187

1. Scope

1.1 This standard specifies the dimensions essential to interchangeability of condenser-reflector, four-pin, prefocus lamps of T-12, TB-12, T-14 and TB-14 bulb sizes in 8 mm motion-picture projectors.

1.2 It is not the intent to prescribe operating characteristics or details of design.

2. Dimensions

2.1 Base and pin dimensions shall be as specified in American National Standard Dimensions for 4-Pin Prefocus Base, C81.57-1968.

2.2 Lamp dimensions shall be as specified in the figure and table.

2.3 Dimension J, maximum bulb excursion, specifies that no portion of the bulb wall shall extend toward the aperture more than J from a plane through the base axis and perpendicular to the optical axis.

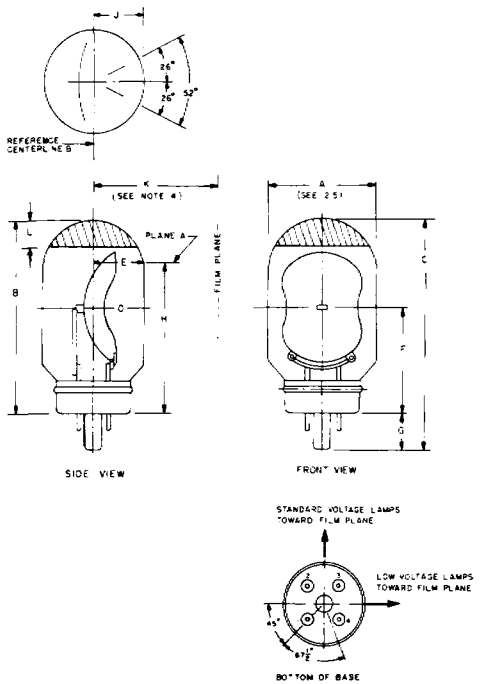
2.4 Dimension E specifies bulb excursion limits at certain potential lamp housing interference points in the projector. Measurements are made in Plane X, parallel to and 2.437 in (61.90 mm [Dimension H] above the base seating plane.

The critical zone in Plane X is an included angle of 52° located as shown in the top view of the lamp. The apex of the 52° angle is located at the intersection of the base axis, Plane X, and Reference Centerline B.

No portion of the bulb wall within the critical 52° angle located in Plane X shall extend more than E from Reference Centerline B.

2.5 Dimension A, maximum bulb diameter, is defined as the diameter of a cylinder coaxial with the axis of the lamp base into which the lamp must fit. (See Note 3.)

2.6 If an opaque top is used, it shall not extend more than 0.630 in (16 mm) from the top of the bulb. (See Note 2.)



Dimensions	Groups	Inches	Millimeters
A (See 2.5)	I, II, IIa*	1.875 max	47.62 max
	III	2.140 max	54.36 max
B	I, II	3.072 max	78.03 max
	IIa*	2.698 max	68.53 max
	III	2.885 max	73.28 max
C	I, II	3.562 max	90.47 max
	IIa*	3.188 max	80.98 max
	III	3.375 max	85.72 max
E (See 2.4)	All	0.800 max	20.32 max
F	All	1.562 nom	39.67 nom
G	All	0.535 ref	13.59 ref
H	All	2.437 min	61.90 min
J (See 2.3)	I, II, IIa*	0.825 max	20.96 max
	III	0.950 max	24.13 max
K (See Note 4)	I, III	1.750 nom	44.45 nom
	II, IIa*	2.250 nom	57.15 nom
L (See Note 2)		0.630 max	16.00 max

*Group IIa lamps are designed primarily for horizontal operation.

3. Operating Position

3.1 Lamps designed for operation up to 50 volts are prefocused with respect to Pins 2 and 4. (See Appendix A1.)

3.2 Lamps designed for operation in the 100-135 volt range are prefocused with respect to Pins 1 and 3. (See Appendix A2.)

4. Group Types

4.1 The variations of reflector-type lamps used in 8 mm applications may be divided into three general groups:

Group I—T-12 and TB-12 (nominal 1½ in [38 mm] diameter) bulb and a 1.750 in (44.45 mm) focal distance.

Group II and IIa—T-12 and TB-12 (nominal 1½ in [38 mm] diameter) bulb and a 2.250 in (57.15 mm) focal distance.

Group III—T-14 and TB-14 (nominal 1¾ in [44 mm] diameter) bulb and a 1.750 in (44.45 mm) focal distance.

NOTE 1: Incandescent projection lamps are usually identified by a three letter code, as specified in American National Standard Method for the Designation of Photo Lamps, C78.370-1969 (R-1963).

NOTE 2: The dimension in Section 2.6 applies to those projection lamps having opaque end coatings. However, there are exceptions, the specifications of which are supplied by the equipment manufacturers.

NOTE 3: Bulb size is defined by the cylinder of Diameter A together with excursion limits in specific areas, as defined by Dimensions E and J. It is possible, therefore, that the bulb shape may be other than T (for tubular or cylindrical), such as the TB (tubular with a bulged, formed face) bulb used for some lamps.

Projector parts, such as the chimney, baffle plates, and aperture must be so located as to ensure adequate clearance between these parts and the bulb surface.

NOTE 4: Focal distance is the recommended dimension from the axis of the lamp base to the film plane. It is not necessarily the focal length of the internal condensing reflector.

Appendix

(The Appendix is not a part of this American National Standard, but is included for information purposes only.)

A1. In those lamps designed for operation up to 50 volts, electrical contact is made through Pins 1 and 2. Pins 3 and 4 are not always electrically isolated from Pin 1 or 2 or both.

A2. In those lamps designed for operation in the 100-135 volt range, electrical contact is made through Pins 1 and 4. Pins 2 and 3 are not always electrically isolated from Pin 1 or 4 or both.

A3. The terms "T-12" and "TB-12" define the general shape and nominal diameter of the bulb. The letter "T" is an abbreviation for tubular, "TB" for tubular with a bulged, formed face. The numbers relate to the nominal diameter in eighths of an inch; e.g., T-12 is a tubular bulb 12/8 inch (38 mm) in diameter.

A4. Both metallic and dichroic internal integral reflectors are used with all groups of projection lamps. Although dichroic reflector lamps of equal wattage can generally be used in place of metallic reflector lamps, the reverse is not true due to the infrared energy reflection and transmission characteristics differences. Metallic reflector lamps should not be substituted for dichroic reflector projection lamp types. Film and equipment damage may result.