NAB STANDARD

CARTRIDGE TAPE RECORDING AND REPRODUCING

NATIONAL ASSOCIATION OF BROADCASTERS
1771 N Street, N.W.
Washington, D.C. 20036

NAB
RECORDING AND REPRODUCING STANDARDS AND GLOSSARY FOR AUDIO MAGNETIC TAPE CARTRIDGE SYSTEMS

The NAB Recording and Reproducing Standards Committee was originally organized in 1941. Standards proposals from the Committee have been adopted by the Board of Directors in 1942, 1949, 1950, 1953, and 1964. The standards contained herein were adopted by the Board in December 1975.

These standards and recommended good engineering practices are for the guidance of the broadcasting industry, and represent the contributions of many of the nation's authorities on the various phases of recording as used by the industry. The NAB Recording and Reproducing Standards Committee has also benefited by contributions made by several international organizations. The committee was open to participation by any interested individual or organization and consisted of representatives from the manufacturers, broadcasters, and producers. Close liaison was maintained with other organizations (as well as foreign countries) to insure the maximum degree of coordinated understanding and recommended standardization, to permit interchangeability and, at the same time, to embrace the latest technological advances of the art.

Nothing in these standards prohibits or discourages continued progress or advancement of the art. On the contrary, the standards are intended to provide stimulus for continued scientific exploration in the field of recording. It is anticipated that when new techniques and developments are evident, the NAB Recording and Reproducing Standards Committee may request submissions thereon looking toward any needed amendments and additions to keep pace with the art as it affects all forms of AM, FM, and a TV broadcasting.

Audio Cartridge Tape Recording and Reproducing Systems

1. General

1.1 *Scope*

The purpose of this standard is to describe and define the NAB Audio Cartridge Tape Recording and Reproducing System. This standard does not apply to special purpose tape cartridge systems which vary significantly from those described in this standard (tape speed, track configuration, noise reduction, etc.). This standard does not include any applicable safety requirements and supersedes the NAB Cartridge Standard dated October 1964.

1.2 *General Description of System and Applications*

This standard applies to an endless loop cartridge system for the recording and reproduction of audio broadcast programs on lubricated magnetic tape.

The NAB cartridge is an enclosure containing an endless loop of lubricated magnetic tape wound in such a fashion as to allow continuous tape motion.

The cartridge case has an opening in its lower side in order to accommodate a pressure roller, a corresponding cutout in the front side for a capstan, and two or more cutouts for insertion of magnetic head(s).

In the working position, the pressure roller pushes the tape against the capstan. At the same time, the pressure roller shaft may position the cartridge via a spring action device or other cartridge member.

The Standard requires either one program track and one cue track for monophonic programs; or two program tracks and one cue track for stereophonic programs.

A standard machine shall have the capability of accepting a single or multiplicity of NAB Size AA, Size AA and BB, or Size AA, BB. and CC cartridges.

A standard machine shall transport the tape, record and/or reproduce the signals recorded thereon in accordance with the requirements herein stated.

A standard cartridge shall maintain the tape in the position and condition shown in Fig. B. The cartridge shall permit the tape to be transported so as to meet the requirements herein stated.

1.3 *Description of Cue System*

This standard employs one track on the tape on which may be recorded four different signals, one each for (a) cueing the tape to a starting point, (b) providing an end of message signal, (c) a third signal, and (d) a fourth signal. Signals (b), (c), and (d) are used externally to the system. Refer to Section 3.4.

1.4 *Fast Wind (High Speed Cueing)*

High speed cueing is an optional feature and is intended for use in advancing the tape at a rate in excess of the normal (7.5 in/s, 190.5 mm/s) playing speed and stopping upon sensing the primary cue signal recorded on the cue track.

1.5 *Environment*

This standard applies when machines and NAB Type AA cartridges are operated in free air circulation under the following conditions:

1.5.1 *Relative Humidity*

Relative humidity not less than 25 percent or more than 80 percent.

1.5.2 *Ambient Temperature*

The ambient temperature shall not be less than 40°F (4°C) or more than 90°F (32°C).

1.5.3 *Power Source*

The line voltage is to be 117 v, ± 10 percent, 1ø, 60 Hz. Alternate voltages and frequencies may be used as specified on the equipment.

1.5.4 *Radio Frequency Interference (RFI)*

Cartridge tape equipment commonly operates in RF fields. The problem of determining a suitable test condition is under study.

2. Mechanical Requirements for Cartridges, Tape, Recording and Reproducing Equipment

2.1 *Mechanical Dimensions*

2.1.1 *Cartridges*

2.1.1.1 *Sizes and Dimensions*

Three cartridge sizes are standard; NAB Type **AA,**

NAB Type BB, and NAB Type CC.[1]

The standard dimensions for NAB Type AA cartridge are shown in Fig. 1.

Dimensions for NAB Type BB and Type CC are shown in Table 1. The dimensions for Type AA apply to Type BB and Type CC except for width and length.

TABLE 1

All Dimensions in Inches

Cartridge NAB type	Width	Length	Height
BB	6.010 5.990	7.025 6.975	.895 .865
CC	7.635 7.615	8.525 8.475	.895 .865

All Dimensions in Millimeters

Cartridge NAB type	Width	Length	Height
BB	152.65 152.15	178.44 177.17	22.73 21.97
CC	193.93 193.42	216.54 215.27	22.73 21.97

2.1.1.2 ***Spring Action Device***

The cartridge spring action device when used, shall meet the requirements shown in Fig. 2.

2.1.1.3 ***Form of the Cartridge Heel***

The cartridge heel shape is not standardized, but must fall within the outline shown in Fig. 1.

2.1.1.4 ***Tape Path***[2]

The running path of the uppermost edge of the tape shall be parallel to the C plane (deck plane) at a distance perpendicular to said plane of 0.562 in. (14.275 mm). Tolerance is ± 0.002 in. (0.051 mm).

No member of the cartridge or playing mechanism shall prevent the tape from running within the prescribed limits. See Fig. 3.

2.1.1.5 ***Tape Tension***

The tape tension measured with tape moving in the direction of normal travel, with heads and external guides eliminated, and any braking system defeated, shall not exceed 3 oz. (0.834 N).

2.1.1.6 ***Tape Orientation***

The magnetic coating shall face the windows at the front of the cartridge, and shall move across the windows from right to left as the cartridge is held with the bottom down and the windows facing the observer. See Fig. 1B.

2.1.1.7 ***Playing Time***

The playing time shall be clearly marked on the cartridge. Loaded cartridges shall contain no less tape than that required to provide the indicated playing time (at 7.5 in/s 190.5 mm/s). Excess tape shall not exceed 3 sec. playing time for playing times up to 100 sec., and not more than 6 sec. for playing times greater than 100 sec.

2.1.1.8 ***Identification***

Cartridges conforming to this standard shall be clearly identified with the appropriate NAB Type (AA, BB, CC).

2.1.1.9 ***Tape Stop Time***

The tape shall stop within 40 msec (maximum) of the transport release at 7.5 in/s (190.5 mm/s), or 80 msec (maximum) equivalent playing time from fastest speed.

[1]The cartridges meeting this standard are similar to the former Type A, Type B and Type C, respectively. Certain differences in the Type AA, BB, and CC may prevent full compatibility with those described in the 1964 NAB Standard.

[2]Fig. 1B gives a dimension for the lower edge of the tape when it is in a relaxed static condition.

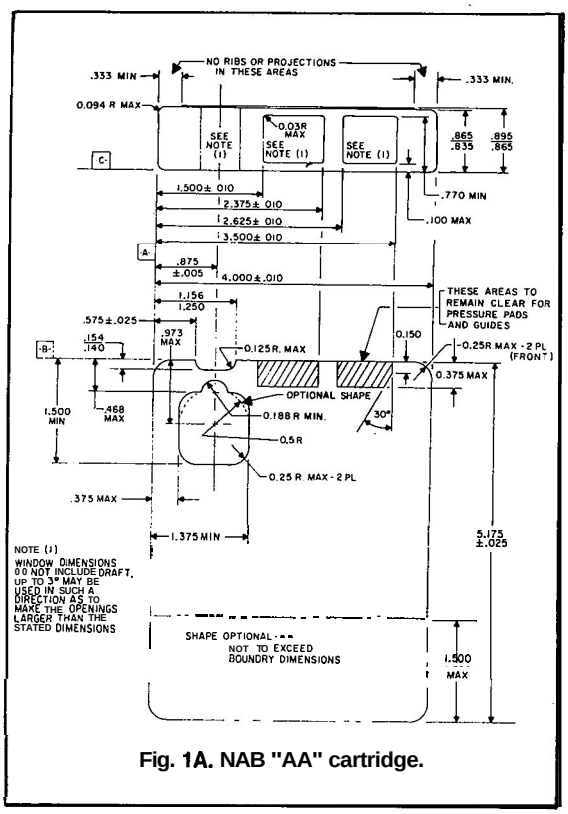

Fig. 1A. NAB "AA" cartridge.

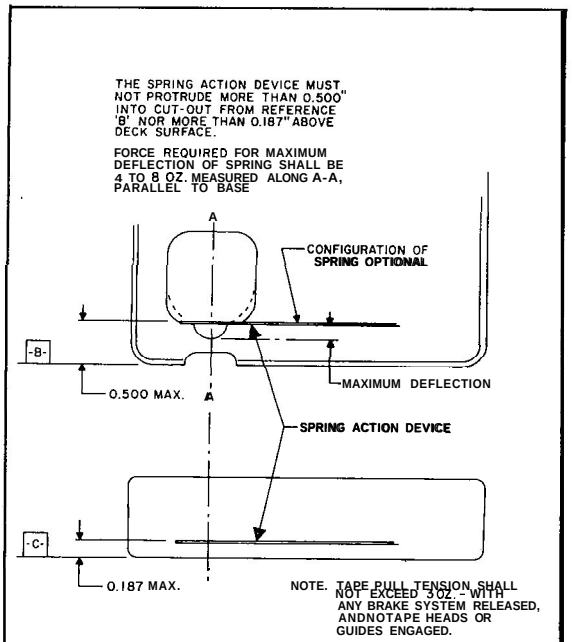

Fig. 2. NAB "AA" cartridge spring action device limitations.

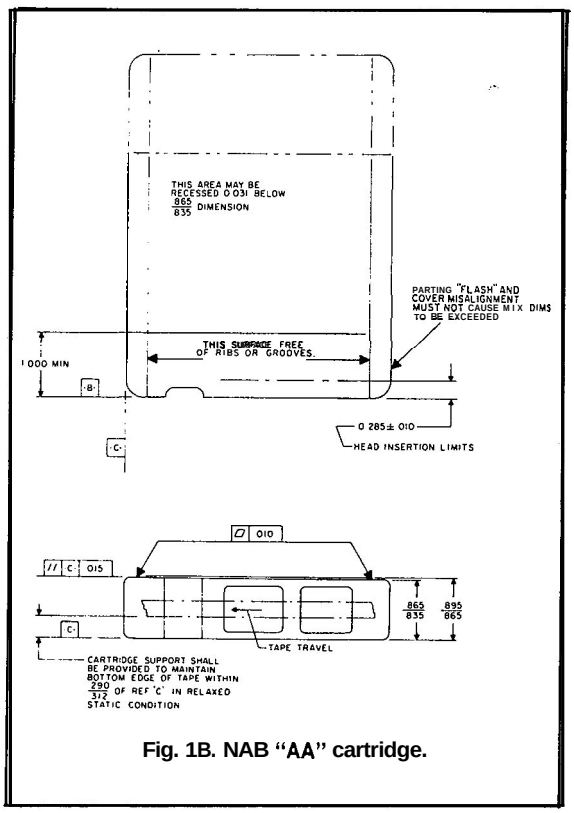

Fig. 1B. NAB "AA" cartridge.

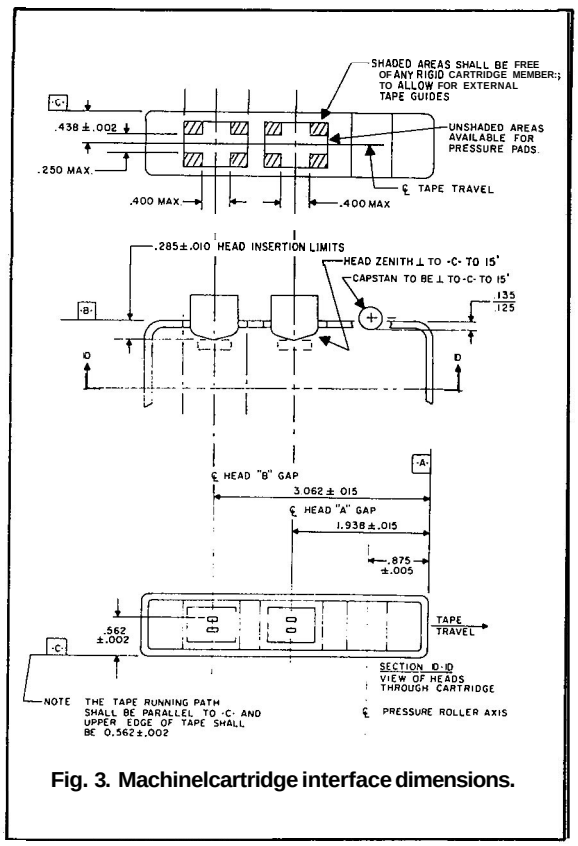

Fig. 3. Machinelcartridge interface dimensions.

2.1.2 *Tape*

2.1.2.1 *Tape Thickness*

Total thickness of tape (base film plus coatings) shall not exceed 1.6 mils (0.04 mm).

2.1.2.2 *Tape Width*

The tape width shall be 0.248 in. +0.000, –0.002. (6.30 mm +0.000, –0.05 mm.)

2.1.2.3 *Tape Lubrication*

Tape used in cartridges shall be lubricated on the side opposite the magnetic coating.

2.1.3 *Transport*

2.1.3.1 *Head Location*

The location of the center line of the gap of each head referenced to Plane **A** shall be as shown in Fig. **3.**

2.1.3.2 *Head Insertion*

The tape contact surface of the head(s) relative to the B plane shall be as shown in Fig. **3.**

2.1.3.3 *Head Zenith*

The tape contact surface of the head(s) shall be perpendicular to C plane within 15 min. of arc as shown in Fig. **3.**

2.1.3.4 *Head/Tape Contact Area*

The tape-to-head contact area shall be within limits as shown in Fig. 3.

2.1.3.5 *Track Reference Dimensions and Formats*

The monophonic track system reference dimensions are given in Fig. 4A. The stereophonic track system reference dimensions are given in Fig. 4B.

2.1.3.6 *Capstan Perpendicularity*

The capstan shall be perpendicular to Plane C (deck plane) within 15 min. of arc.

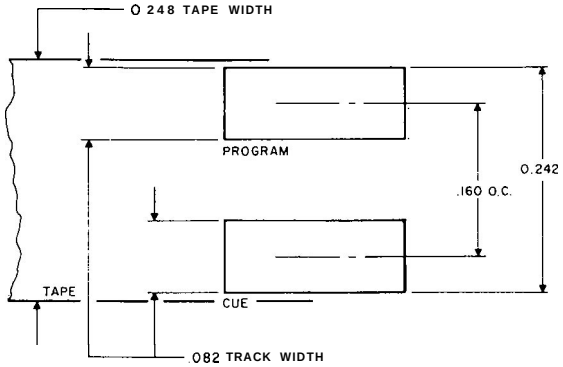

Fig. 4A. ,Mono track system reference dimensions.

2.2 *Transport Performance*

2.2.1 *Tape Speed*

The standard tape speed shall be 7.5 in/s (190.5 mm/s) tolerance shall be ± 0.2 percent.

2.2.2 *Fast Wind (Optional)*

2.2.2.1 *Maximum Tape Speed*

The maximum tape speed shall be 30 in/s (762 mm/s) in fast wind mode (Mechanical considerations for tape and cartridge).

2.2.2.2 *Initiate Fast Wind Mode*

The fast wind mode shall be initiated by the trailing edge of the secondary cue tone (EOM) for automatic, or by actuation of a contact closure or equivalent for manual operation.

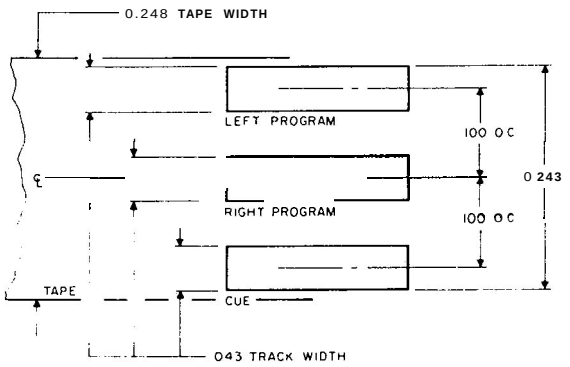

Fig. 4B. Stereo track system reference dimensions.

2.2.2.3 *Inhibit Start Command*

When stopping from the fast wind mode, the start command is to be inhibited for the maximum motor speed transition time (from fast to normal speed).

2.2.2.4 *Defeat Fast Wind Mode*

Machines with fast wind shall have a switch to allow the defeat of automatic fast wind mode. When in a recording mode, fast wind operation shall be defeated.

2.2.3 *Transport Stop Time*

The transport stop time shall be 80 msec. maximum at 7.5 in/s (190.5 mm/s); 120 msec. divided by the ratio of fast wind speed to 7.5 in/s (190.5 mm/s) when set in the recommended minimum time release adjustment or mode.

2.2.4 *Transport Start Time*

The transport start time from initiation of start command shall be 120 msec. maximum to first reach 7.5 in/s (190.5 mm/s).

2.2.5 *Maximum Temperature Rise*

The maximum temperature rise above ambient for any machine part in long-term contact with the tape or cartridge shall be 50°F (28°C).

2.2.6 *Flutter*

The weighted peak flutter of the reproducer shall be less than ± 0.15 percent measured according to ANSI S4.3, using a flutter test tape as described in Section 4.4 of this standard.

2.2.7 *Phase Difference (Stereo)*

The peak stereophonic phase difference shall not exceed 90° at 12.5 Hz.

3. Electrical Requirements for Recording and Reproducing Equipment

3.1 *Equalization*

3.1.1 *Recorded Tape Flux Characteristic*

The standard characteristic of the short circuit magnetic tape flux (and also the fluxivity) versus frequency shall fall with increasing frequency in conformity with the impedance of a parallel combination of a capacitance and a resistance having a time constant of 50 microseconds. Refer to Table 2 and Fig. 5.

3.2 *Standard Tape Reference and Operating Level*

3.2.1 *Reference Fluxivity*

For all measurements in this standard, the reference fluxivity shall be 160 nWb/m at 1 kHz as measured according to ANSI S4.6.

3.2.2 *Standard Operating Level*

The standard operating level is not specified.

160 nWb/m at 1 kHz is recommended if a VU Meter, or instrument of similar characteristics is used in the recording process with currently available magnetic tape.

3.3 *Program System Performance Requirements*

3.3.1 *Minimum Input Level*

3.3.1.1 *Reproducer Limit*

The maximum gain of the reproducer shall be such that a recorded fluxivity of

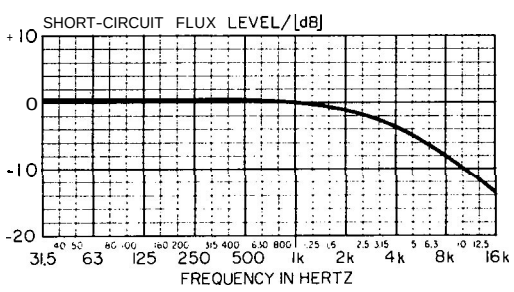

Fig. 5. Standard recorded tape short circuit flux characteristic.

50 nWb/m at 1 kHz (10 dB below reference fluxivity) will produce at least 0 dBm output level.

3.3.1.2 ***Recorder Limit***

The recorder shall be capable of recording a 1 kHz signal at reference fluxivity from the following minimum input levels: –22 dBm (60 mv/600 ohms, or 30 mv/150 ohms) 600/150 ohm connection; –8 dBm (300 mv/600 ohms), –2 dBm (300 mv/150 ohms) bridging connection.

3.3.2 ***Maximum Input Level***

3.3.2.1 ***Reproducer Limit***

The reproducer shall be capable of reproducing no less than 1250 nWb/m equivalent input fluxivity at 1 kHz (18 dB above reference fluxivity).

3.3.2.2 ***Recorder Limit***

The record amplifier shall be capable of accepting the following maximum levels: 0 dBm (780 mv/600 ohms or 390 mv/150 ohms) 600/150 ohm connection; +14 dBm (4.0 mv/600 ohms), +20 dBm (4.0 mv/150 ohms) bridging connection.

3.3.3 ***Amplitude/Frequency Response***

3.3.3.1 ***Reproducer Limit***

When reproducing a calibration tape meeting the requirements of paragraph 4, the output level of the reproducer shall be within a 2 dB window from 315 Hz to 10 kHz, 3 dB window from 150 to 314 Hz, 5 dB window from 50 to 149 Hz, and opening from 2 to 3 dB between 10 and 16 kHz, as shown in Fig. 6B, with the upper limit of the window to be flat from 20 Hz to 20 kHz.

3.3.3.2 ***Recorder Limit***

When recording a tape and comparing its reproduced output with that of an NAB Standard test tape, the difference shall be within a 2 dB window from 50 Hz to 10 kHz, and opening from 2 to 3 dB between 10 kHz and 16 kHz, as shown in Fig. 6A.

3.3.3.3 ***Level Difference (Stereo)***

The maximum level difference between stereo program channels shall be 1.5 dB for a reproducer, and 3.0 dB for a recorder/reproducer over the frequency range from 50 Hz to 16 kHz.

3.3.4 ***Total Harmonic Distortion***

3.3.4.1 ***Reproducer Limit***

The total harmonic distortion of the reproducer at +18 dBm output (from 50 Hz to 16 kHz) shall be less than 0.5 percent.

3.3.4.2 ***Recorder Limit***

The total harmonic distortion of the record amplifier at 1 kHz, with a level 18 dB above that required to record 160 nWb/m on currently available magnetic tape, shall be less than 0.5 percent.

3.3.4.3 ***System Limit***

The total harmonic distortion when recording and reproducing 160 nWb/m at 1 kHz, on currently available tape, shall be less than 2.0 percent.

With a 1 kHz tone recorded with peak bias on any lubricated tape at a level which produces 3.0 percent rms 3rd harmonic distortion, the distortion should result mainly from the tape nonlinearity and not from the recording or reproducing amplifiers.

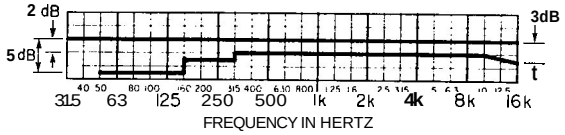

Fig. 6A. Record chafacteristic tolerance.

3.3.5 *Signal/Noise Ratio*

3.3.5.1 *Reproducer Limit*

The reproducer signal-to-noise ratio shall be measured unweighted with a bandpass of 20 Hz to 20 kHz ***without tape running,*** but with an otherwise fully operating reproducer, from 160 nWb/m at 1 kHz reference level. The minimum signal-to-noise ratio shall be 50 dB for mono and 47 dB for stereo.

3.3.5.2 *System Limit*

The system signal-to-noise ratio shall be measured unweighted with a bandpass of 20 Hz to 20 kHz, using a tape recorded with bias but with no signal, from 160 nWb/m at 1 kHz reference level. The minimum system signal-to-noise ratio shall be 47 dB for mono and 44 dB for stereo.

3.3.6 *System Crosstalk*

3.3.6.1 *Stereo Program Crosstalk*

Stereo program crosstalk shall be measured at 50 Hz, 1 kHz, 10 kHz with 160 nWb/m and 50 nWb/m respective fluxivities, correct source and load impedances, and with normal gain control settings. The maximum stereo program crosstalk shall be –45 dB.

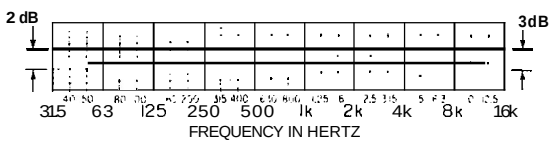

Fig. 6B. Reproduce characteristic tolerance.

3.3.6.2 *Cue to Program Crosstalk*

Cue to program crosstalk shall be measured at 150 Hz, 1 kHz, 3.5 kHz and 8 kHz, with nominal levels, correct source and load impedances, and with normal gain control settings. The maximum cue to program crosstalk shall be –50 dB.

3.3.7 *Channel Phasing (Stereo)*

3.3.7.1 *Record Polarity*

In-phase stereo inputs to record amplifier input terminals shall produce in-phase magnetic signals on the tape (as from a full-track record head).

3.3.7.2 *Reproduce Polarity*

In-phase magnetic signals on the tape (as from full-track recording) shall be reproduced as in-phase stereo signals at the reproduce amplifier output terminals.

3.3.7.3 *Phase Difference*

The peak phase difference between stereo channels (record and subsequently reproduce) shall be less than 90° for all frequencies between 50 Hz and 12.5 kHz.

3.3.8 *Interface Impedances*

The recorder and/or reproducer shall be required to meet all of the specifications of this standard only when properly terminated in the rated source and load impedances.

3.3.8.1 *Reproducer Load Impedance*

The reproducer rated load impedances shall be 600 ohms on output connection ***and*** 150 ohms available on external connection or by internal wiring.

3.3.8.2 *Reproducer Output Impedance*

The reproducer output impedances shall not exceed 0.125 times the rated load impedance (75 ohms maximum for 600 ohms rated load, 18.8 ohms maximum for 150 ohms rated load), over the frequency range from 50 Hz to 16 kHz.

3.3.8.3 *Recorder Source Impedance*

The recorder source impedance shall be 150 ohms or less; on the 150 ohm connection, or 600 ohms or less on the 600 ohm connection.

3.3.8.4 *Recorder Input Impedance*

The recorder input impedances shall be 8 (minimum) times the rated source impedance (4,800 ohms minimum for 600 ohms rated source, 1,200 ohms minimum for 150 ohms rated source), and 10,000 ohm minimum bridging over the frequency range from 50 Hz to 16 kHz.

3.3.8.5 *Input/Output Connections*

The program record input and reproduce output connections shall be floating (ungrounded), capable of being connected to sources/loads with either side or centerpoint grounded while meeting all other specifications.

3.4 *Cue System Performance Requirements*

3.4.1 *Required and Optional Cue Facilities*[3]

There shall be a primary cue system in NAB Standard Cartridge Tape Recorders and Reproducers. All other cue/logging facilities are optional. When used, the optional Secondary, Tertiary and Logging cue tones shall be as assigned in paragraph 3.4.2, the cue sensor limits shall be as specified in paragraph 3.4.6; and all other requirements listed in paragraph 3.4 for cue system performance must be met.

3.4.2 *Cue/Logging Generator Frequencies and Tolerances*

Primary cue: 1 kHz, ± 50 Hz.
Secondary cue: 150 Hz, ± 8 Hz.
Tertiary cue: 8 kHz, ± 400 Hz.
Logging signal: 3.5 kHz, ± 150 Hz for single-tone On/Off system.
3.3 kHz to 3.7 kHz maximum window for FSK logging system.

3.4.3 *Cue/Logging Tone Levels*

3.4.3.1 *Recorded Fluxivity*

Primary cue: 160 nWb/m, +20 nWb/m, –40 nWb/m.

Secondary cue: 360 nWb/m, +40 nWb/m, –110 nWb/m.

Tertiary cue: 20 nWb/m, +2 nWb/m, –6 nWb/m.

Logging signal: 35 nWb/m, +5 nWb/m, –10 nWb/m.

3.4.3.2 *Relative Output Levels*

When a tape with standard recorded cue tones is reproduced through an amplifier having the ideal NAB reproducing characteristic and compared to the NAB Standard Tape Reference Fluxivity (paragraph 4.2.1.2), the corresponding relative output levels are:

Primary cue: 0 dB standard, +1 dB maximum, –3 dB minimum (+1 –3 dB).

Secondary cue: +6 dB standard, +7 dB maxi-

[3] Recording of the Secondary cue, Tertiary cue and Logging signals shall be possible during the record and reproduce modes of the cartridge machines without causing any of the parameters to exceed the specified limits.

mum, +3 dB minimum (+1 -3 dB).

Tertiary cue: –10 dB standard, –9 dB maximum, –13 dB minimum (+1 -3 dB).

Logging signal: –10 dB standard, –9 dB maximum, –13 dB minimum (+1 –3 dB).

3.4.4 *Cue/Logging Tone Distortion*

The total harmonic distortion as recorded on the tape at the frequencies and levels listed above shall not exceed 5.0 percent.

3.4.5 *Cue/Logging Tone Duration*

Primary cue: 500 msec. minimum, 750 msec. maximum.

Secondary cue: 100 msec. minimum (15 cycles at 150 Hz), no maximum specified.

Tertiary cue: 2 msec. minimum (16 cycles at 8 kHz), no maximum specified.

Logging signal: No minimum or maximum specified. External logging encoding and decoding systems may have differing requirements.

3.4.6 *Cue Sensor Requirements*

3.4.6.1 *Cue Sensor Operation*[4]

The individual cue sensors shall operate satisfactorily with the levels listed in Section 3.4.3 for tones within the frequency tolerances listed below:

Primary cue: 1 kHz ± 100 Hz.

Secondary cue: 150 Hz ± 15 Hz.

Tertiary cue: 8 kHz ± 800 Hz.

Logging signal: No tolerance specified.

3.4.6.2 *Primary Cue Sensor Inhibitor*

A Primary cue sensor inhibit timer shall be incorporated to prevent the operation of the Primary cue sensor until after the Primary cue tone has initially passed the cue reproduce head. The duration of the inhibit or protect timer shall be 1.75 sec., ± 0.25 sec.

3.4.6.3 *Protection against False Cueing*

The Primary, Secondary and Tertiary cue sensors shall not respond to other standard cue or logging tones within the frequency tolerances listed in Section 3.4.2 (and with up to 6 dB above standard levels in 3.4.3 with no more than 5 percent distortion) when either in the normal speed or fast speed mode of operation.

3.4.7 *Cue Sensor External Switching Requirements*

The Secondary and Tertiary cue sensors shall have a ground switching output when the optional sensors are provided. The switching circuit shall be one-side grounded with a current sinking capability of at least 50 mA., voltage rating of at least +25 v when open and, with 50 mA. current, shall have 0.4 v maximum voltage drop across the switch when closed.

Protection shall be included to prevent damage of the switching circuit components with a reverse voltage of up to –25 v, and a reverse current of up to 100 ma. in the event the load switching supply is reversed in polarity.

3.4.8 *Logging Input/Output Requirements*

3.4.8.1 *Input Level*

The required input logging signal shall be 0.5 v., ± 0.25 v RMS level for a tape fluxivity of 35 nWb/m.

[4]The external logging system sensor must reject the Primary, Secondary and Tertiary cue signals at the maximum specified levels for error-free operation.

3.4.8.2 *Input Impedance*

The logging input impedance shall be 10,000 ohms minimum. The input may be one-side grounded.

3.4.8.3 *Output Level*

The required logging output level shall be 0.5 v, ± 0.25 v RMS from a logging signal of 35 nWb/m tape fluxivity.

3.4.8.4 *Load Impedance*

The logging load impedance shall be 10,000 ohms minimum. The output may be unbalanced.

3.4.8.5 *Protection From External Cue Tones*

The output circuit shall provide 40 dB minimum isolation for internal cue sensors from external cue signals appearing on the output connector from other machines connected in parallel with the output.

3.4.8.6 *Logging Output Distortion*

The total harmonic distortion for Primary, Secondary and Tertiary cue tones, and for Logging tones appearing at the logging output, recorded at maximum levels with up to 5.0 percent distortion on the tape shall be 7.0 percent maximum.

3.5 *Remote Input Switchinp Requirements*

3.5.1 *Reproducer Requirements*

Connections and circuitry for start and stop remote switching functions shall be provided in reproducers.

3.5.2 *Recorder Requirements*

Record set remote switching functions shall be provided in recorders. Connections and circuitry for secondary and tertiary cue remote record switching functions shall be provided when these optional facilities are provided in the recorder.

3.5.3 *Voltage and Current Requirements*

All circuits for remote switching shall be one-side grounded and capable of operation by the closure of an external normally open set of contacts, or equivalent. They shall operate from a positive supply voltage, with + 25 v maximum appearing on the switching terminals.

They shall require no more than 50 mA. current for operation, and shall operate when the switching voltage is pulled down to +0.4 v with respect to ground by the external switch.

Proteciton shall be included to prevent damage of the switching circuit components with a sustained reverse current of up to 100 mA. in the event an external supply is connected to the switching terminals.

3.5.4 *Response Time*

The switching circuits of 3.5.1 and 3.5.2 shall operate with a switch closure of 40 msec. or more.

4. Calibration/Test Tapes

4.1 *Label Information*

The cartridge shall be labeled. It shall state the test tape category, tape speed, NAB Standard and edition, the manufacturer and catalog number, and the track format.

4.2 *Spot Frequency Calibration Tape*

There is nothing at the present time for Section 4.2.

4.2.1 *General*

4.2.1.1 *Reference Frequency*

The reference frequency for calibration tapes shall be 1000 Hz.

4.2.1.2 *Reference Fluxivity*

The reference fluxivity for calibration tapes shall be an RMS short-circuit flux per unit track width of 160 nWb/m of track width

at 1000 Hz, as measured according to ANSI S4.6-1973.

4.2.1.3 *Flux versus Frequency*

The recorded tape flux versus frequency shall be as given by the following equation:

$$(f) = 1/^2\ [1+(f/3180)^2]$$

where f is the frequency in Hz.

4.2.2 *Tolerances*

4.2.2.1 *Recorded Frequencies*

The recorded frequencies, when reproduced at the standard speed, shall be the specified values ± 1 percent.

4.2.2.2 *Reference Fluxivity*

The reference fluxivity shall be the specified value ± 3 percent.

4.2.2.3 *Flux versus Frequency*

The fluxivity versus frequency shall be the specified value in Table 2 ± 0.5 dB up to the frequency of 10 kHz, and $- 1.0 dB for frequencies above 10 kHz.

4.2.2.4 *Azimuth Angle*

The tape flux shall be parallel to the longitudinal axis of the tape with an azimuth alignment error across the entire track width not to exceed ± 0.2 milliradians (40 sec.).

4.2.3 *Recorded Tracks*

4.2.3.1 *Monophonic*

The recorded test signals may be recorded on the program track shown in Fig. 4A, or they may be recorded across the entire upper 0.16 in. (4 mm) of the tape.

4.2.3.2 *Stereophonic*

The recorded test signals may be recorded on the two program tracks shown in Fig. 4B, or they may be recorded (with fringing compensation) across the entire upper 0.16 in. (4 mm) of the tape.

4.2.4 *Test Tape Format*

4.2.4.1 *Announcements*

Each test tone shall be preceded by a voice announcement.

4.2.4.2 *Format*

The calibration tape shall contain at least the following frequencies, durations, and levels, preferably in the following sequence:

Frequency (Hz)	Duration (sec.)	Level (dB)	Function
1,000	5	- 0	Cue (Recorded on Cue Track)
1,000	20	0	Reference Fluxivity
1,000	10	-10	Response reference level
12,500	30	-10	Azimuth & phase calib.
50	5	-10	
63	5	-10	
125	5	-10	
250	5	-10	
500	5	-10	
1,000	5	-10	
2,000	5	-10	
4,000	5	-10	
8,000	5	-10	
10,000	5	-10	
12,500	5	-10	
16,000	5	-10	
1,000	20	0	Reference fluxivity

4.3 *Standard Speed/Timing Tape*

4.3.1 *Accuracy Requirement*

The speed timing error, when used within manufacturer's specified environmental conditions, traceable to a recognized timing standard such as the National Bureau of Standards, shall be less than 0.2 percent.

4.3.2 *Minimum Load Requirement*

The speed/timing cartridge shall contain no less than 2 min. of 1 mil base film lubricated tape, at standard operating speed of 7.5 in/s (190.5 mm/s), and shall be recorded on the top 0.082 in. track.

4.3.3 *Instructions for Use*

Instructions for use shall be stated in a concise and unambiguous way, since several differing types of test tapes are available. Instrumentation requirements and practical alternates shall be described, along with possible areas of error in their use.

4.4 *Flutter Test Tape*

4.4.1 *Frequency and Level*

The flutter test tape shall be recorded at 3150 Hz ± 1.0 percent at 120 nWb/m ± 2 dB and to the requirements of ANSI S4.3.[5]

4.4.2 *Peak Flutter Content*

The weighted peak flutter content, when loaded in a cartridge shall not exceed ± 0.05 percent.

4.4.3 *Minimum Load Requirement.*

The flutter test cartridge shall contain no less than 3% min. of 1 mil base film lubricated tape at a standard operating speed of 7.5 in/s.

4.5 *Swept-Frequency Test Tape*

4.5.1 *General*

Two sweep modes are required: a rapid sweep followed by a slow sweep.

4.5.1.1 *Monophonic Test Tape*

The monophonic swept-frequency test tape shall be recorded on the top 0.082 in. (2.08 mm) track.

4.5.1.2 *Stereophonic Test Tape*

The stereophonic swept-frequency test tape shall be recorded in-phase ± 10° maximum. It shall be recorded either on the top and center 0.043 in. (1.09 mm) tracks or full track (cue track erased) provided fringing factor corrections are noted.

4.5.2 *Fast Sweep Test Tape*

4.5.2.1 *Voice Announcement*

No voice announcement is required.

4.5.2.2 *Cue Tones*

The tape shall be recorded without primary cue tones and shall have 2 sec. of silence between sweeps.

4.5.2.3 *Format*

The fast sweep section shall start with 20 sec. of 1 kHz signal recorded at a –10 dB level ± 0.5 dB referenced to the 160 nWb/m Standard Reference Fiuxivity. The 1 kHz Standard Reference Fluxivity shall be followed by 1 min. of the repetitive sweep frequency from 500 Hz to 16 kHz at the same level and at a 100 msec. sweep rate. The frequency shall change logarithmically in respect to time.

4.5.3 *Slow Sweep Section*

4.5.3.1 *Voice Announcements*

The frequencies shall be announced at a level low enough not to interfere with measurement accuracy.

4.5.3.2 *Cue Tones*

The slow frequency sweep calibration tape shall include the primary cue tone recorded one sec. before the beginning of each sweep.

4.5.3.3 *Format*

The slow sweep section shall follow the fast sweep section of the Sweep-Fre-

[5] American National Standard Institute.

quency Test Tape with three cycles of a repetitive sweep frequency recorded at a –10 dB level ± 0.5 dB referenced to the 160 nWb/m Standard Reference Fluxivity. The sweep frequency shall be 50 Hz to 16 kHz at a 25 sec. sweep rate. The frequency shall change logarithmically in respect to time.

4.6 *Cue/Logging Test Tape*

4.6.1 *Mono Test Tape*

The mono cue/logging test tape shall be recorded on the bottom 0.082 in. (2.08 mm) cue track.

4.6.2 *Stereo Test Tape*

The stereo cue/logging test tape shall be recorded on the bottom 0.043 in. (1.09 mm) cue track.

4.6.3 *Test Tape Format*

Using 160 nWb/m, ± 0.25 percent as 0 dB reference, the following tones shall be recorded within ± 0.5 percent of the nominal frequencies and within ± 0.5 dB of the specified levels, with a maximum total harmonic distortion of 5.0 percent. Each test tone is to be preceded by a voice announcement on the top track.

Freq.	Time	Level	Function
		THRESHOLD SENSITIVITY	
1 kHz	10 sec	— 7 dB	Primary threshold
150 Hz	10 sec	— 1 dB	Secondary threshold
8 kHz	10 sec	—17 dB	Tertiary threshold
		LOGGING TONE	
3.5 kHz	10 sec	—10 dB	Logging, nominal level
3.35 kHz[a]	10 ms[b]	—10 dB	
3.65 kHz[a]	10 ms	—10 dB	
		STANDARD LEVEL AND DURATION	
1 kHz[a]	500 ms	0 dB	Primary minimum tirne
150 Hz[a]	100 ms	+ 6 dB	Secondary minimum time
8 kHz	2 ms	—10 dB	Tertiary minimum time
		BANDWIDTH SELECTIVITY	
900 Hz	500 ms	— 3 dB	Primary limits
1100 Hz	500 ms	— 3 dB	
135 Hz	100 ms	+ 3 dB	Secondary limits
165 Hz	100 ms	+ 3 dB	
7200 Hz	2 ms	—13 dB	Tertiary limits
8800 Hz	2 ms	—13 dB	

[a]Repeat four times.
[b]ms = millisecond.

TABLE 2

Standard Recorded Tape Short Circuit Flux Characteristic (50 μsec)

Frequency (in Hz)	Flux Level (in dB)	Frequency (kHz)	Flux Level (in dB)
16	+.41	1	0
25	+.41	1.25	— .21
31.5	+.41	1.6	— .57
40	+.41	2	— 1.04
50	+.41	2.5	— 1.68
63	+.41	3.15	— 2.56
80	+.41	4	— 3.70
100	+.41	5	— 4.99
125	+.40	6.3	— 6.51
160	+.40	8	— 8.23
200	+.39	10	— 9.95
250	+.38	12.5	—11.74
315	+.37	16	—13.78
400	+.34	20	—15.66
500	+.30		
630	+.24		
800	+.14		

Relative flux level calculated by:

$$-10 \text{ Log} \left[1 + \left(\frac{f}{F}\right)^2\right]$$

where f is the frequency of interest and F is the transition frequency (3,183 Hz for 50 μsec.). The expression gives attenuation, with no attenuation for Zero Hz. The table is normalized for reference level at 1 kHz.

APPENDIX A

Glossary of Magnetic Cartridge Tape Recording and Reproducing Terms and Definitions

Azimuth Error, Mean (average)—The signal loss in each of two or more heads due to gap misalignment when adjusted for phase coincidence.

Cue Tones—Recorded audio frequencies of specified duration arranged in a physical fashion on the recorded tape so as to provide a signaling system available for positioning the tape at the start of message and/or such auxiliary functions as may be necessary and desirable.

Cue Track—That portion of the tape upon which the cue tones are recorded.

Flux (recorded)—A measure of the amplitude of the signal recorded on the magnetic tape.

Fluxivity—The name of short-circuit flux per unit track width. The usual multiple of the unit is nanoWebers per meter (nWb/m).

Gap Scatter—An expression for the horizontal displacement of two or more head gaps.

Logging Input—An external recording input connection to the cue track for the purpose of recording logging information.

Logging Output—An output connection from the cue channel for the purpose of reproducing logging information.

Logging Signal (tone)—Tones within an assigned frequency band used for the recording of logging information.

Motor Transition Time—The time in seconds for the tape drive motor to change from high to standard operating speed.

Primary Cue System—The tone and sensor used to cue the tape to the beginning of the recorded program.

The following organizations contributed to the formulation of these standards:

American Broadcasting Company, New York, N.Y.
Ampex Corporation, Redwood City, California
Armed Forces Radio and TV Services, Hollywood, California
Audio Devices, Glennbrook, Connecticut
Beau Motors, North Haven, Connecticut
British Broadcasting Company, London, England
Broadcast Electronics, Silver Spring, Maryland
CBS, Inc.—Radio Division, New York, N.Y.
Consolidated Electronic Corporation Pty. Ltd., Melbourne, Australia
Fidelipac Division, Tele-Pro Industries, Cherry Hill, N.J.
Harris Corporation, Quincy, Illinois
IGM/NTI, Billingham, Washington
Independent Broadcasting Association, London, England
International Tapetronics Corporation, Bloomington, Illinois
Magnetic Reference Lab., Inc., Palo Alto, California
Marathon Products Corporation, West Boylston, Massachusetts
Mag-Tech., Inc., New York
Marathon Products Corporation, West Boylston, Massachusetts
Mastertone Co., Tapex Cartridge, West Des Moines, Iowa
Minnesota Mining and Manufacturing, St. Paul, Minnesota
National Broadcasting Company, New York, N.Y.
Nortronics, Minneapolis, Minnesota
Plough Broadcasting, Memphis, Tennessee
RCA Corporation, Camden, New Jersey
RCA Records, Indianapolis, Indiana
Radio Station WCFL, Chicago, Illinois
Rogers Broadcasting Ltd., Toronto, Ontario, Canada
Schaeffer Electronics Corporation, Goleta, California
Selkirk Holdings, Toronto, Ontario, Canada
Sono-Mag Corp., Bloomington, Illinois
Tapecaster TCM, Inc., Rockville, Maryland
Telex Communications, Inc., Minneapolis, Minnesota
Western Broadcasting-Aristocart Division, Vancouver, B.C., Canada