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Continuous-Recording Voice-Logging Tape Recorders

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Paul Cascarano, Assistant Director
National Institute of Justice

Technology Assessment Program

NIJ Standard for Continuous-Recording Voice-Logging Tape Recorders

NIJ Standard-0220.00

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July 1983

U. S. DEPARTMENT OF JUSTICE
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James K. Stewart, Director

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NIJ STANDARD FOR CONTINUOUS-RECORDING VOICE-LOGGING TAPE RECORDERS

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FOREWORD

This document, NIJ Standard-0220.00, Continuous-Recording Voice-Logging Tape Recorders, is an equipment standard developed by the Law Enforcement Standards Laboratory of the National Bureau of Standards. It is produced as part of the Technology Assessment Program of the National Institute of Justice. A brief description of the program appears on the inside front cover.

This standard is a technical document that specifies performance and other requirements that equipment must meet to conform to the needs of criminal justice agencies for high quality service. Purchasers can use the test methods described in this report to determine firsthand whether a particular piece of equipment meets the standard, or they may have the tests conducted on their behalf by a qualified testing laboratory. Procurement officials may also refer to this standard in their purchasing documents and require that equipment offered for purchase meet the requirements, with compliance guaranteed by the vendor or attested to by an independent laboratory.

Because this NIJ standard is designed as a procurement aid, it is necessarily highly technical. For those who seek general guidance about the capabilities of continuous-recording voice-logging tape recorders, user guides also are published. The guides explain in nontechnical language how to select equipment capable of the performance required by an agency.

NIJ standards are subjected to continuing review. Technical comments and recommended revisions are welcome. Please send suggestions to the Program Manager for Standards, National Institute of Justice, U.S. Department of Justice, Washington, DC 20531.

Before citing this or any other NIJ standard in a contract document, users should verify that the most recent edition of the standard is used. Write to: Chief, Law Enforcement Standards Laboratory, National Bureau of Standards, Washington, DC 20234.

Lester D. Shubin
Program Manager for Standards
National Institute of Justice

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NIJ STANDARD FOR CONTINUOUS-RECORDING VOICE-LOGGING TAPE RECORDERS

1. PURPOSE AND SCOPE

The purpose of this standard is to establish performance requirements and test methods for 24-h continuous-recording multichannel reel-to-reel voice-logging tape recorders used by law enforcement agencies. A drawing of a typical recorder is shown in figure 1.

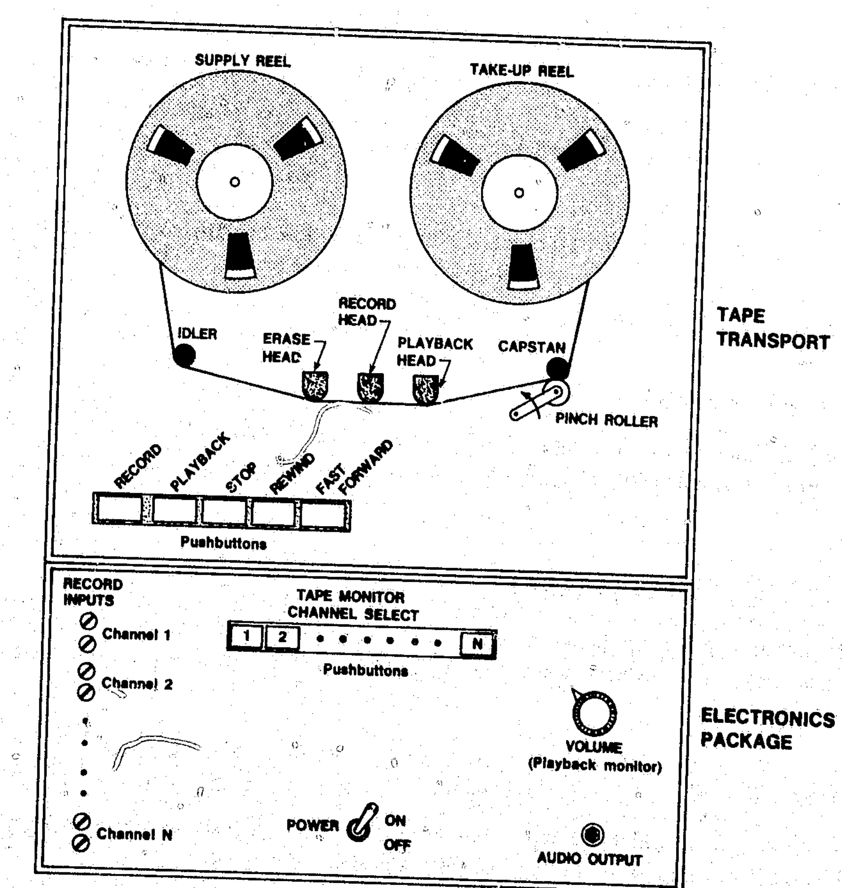

FIGURE 1. *Typical tape recorder showing the controls and terminals used during the tests.*

2. CLASSIFICATION

None.

3. DEFINITIONS

The principal terms used in this document are defined in this section. Because the definitions have been tailored to this standard, they may differ slightly from usage found elsewhere.

3.1 Audio Output Power

The audio power that the recorder can deliver to an external 8-Ω resistive load during playback, when the output signal has 5 percent (i.e., –26 dB) combined second- and third-harmonic distortion.

3.2 Automatic Gain Control

A process by which the output of a device is automatically adjusted in a specified manner as a function of the input. For this standard, the automatic gain control circuitry acts as a limiter, keeping the tape signal level from saturation at times of very strong signal inputs.

3.3 Fast Forward Mode

The operating mode in which the tape moves at high speed in the direction that is used for recording.

3.4 Flutter

Frequency modulation caused by tape speed variations within the approximate frequency range of 6 to 100 Hz that may result in a roughening of the sound quality of the recorded signal.[1]

3.5 Full-Recorded Level

Any recorded signal whose tape signal level is at least 32 dB above the overall noise voltage and produces less than 3 percent rms combined second- and third-harmonic distortion when played back.

3.6 Overall Noise Voltage (ONV)

The signal that appears at the tape recorder audio output jack, measured with a true rms voltmeter using unrecorded tape, with the recorder operating in the playback mode and with a known system frequency response and recorder volume setting.

3.7 Playback Mode

The operating mode in which the tape passes over the playback head in the same direction as when in the record mode, and the recorded signal is sensed and amplified to drive the speaker.

[1] *Method for Measurement of Weighted Peak Flutter of Sound Recording and Reproducing Equipment,* IEEE Std 193-1971, 8 pages.

3.8 Record Mode

The operating mode in which the tape passes over the erase head, where any previously recorded signal is erased, then passes over the record head where the new signal is transferred to the tape, and finally passes over the playback head where the newly recorded signal is monitored.

3.9 Rewind Mode

The operating mode in which the tape moves at high speed in the direction opposite to that of the record mode.

3.10 Rms (Root-Mean-Square)

The value of an electric signal voltage which is equal to the value of the steady direct-current voltage that would produce the same heating power if connected to the same resistor as was the original signal.

3.11 Second-Harmonic Distortion

The ratio of the voltage of the second harmonic to the voltage of the fundamental frequency, both measured at the tape recorder audio output jack during playback.

3.12 Signal-to-Noise Ratio

The ratio of the voltage produced by the maximum tape signal level to that produced by the zero tape signal level, measured at the audio output jack with a true rms-responding voltmeter, and with the tape recorder operating in its playback mode.

3.13 Tape Signal Level

An approximation of the strength of the permanent magnetic record that is on the recording tape. The ratio, expressed in decibels, of the playback signal voltage to the overall noise voltage at the audio output jack, measured by a voltmeter preceded by an appropriate bandpass filter.

3.14 Third-Harmonic Distortion

The ratio of the voltage of the third harmonic to the voltage of the fundamental frequency, both measured at the tape recorder audio output jack during playback.

3.15 Time Code Channel

A special purpose tape channel that is used to record and play back digitally coded time-of-day information.

3.16 Weighted Peak Flutter and Wow

A method of measuring flutter and wow which yields values in reasonable agreement with results obtained from listening tests.

3.17 Wow

Frequency modulation caused by tape speed variations within the approximate frequency range of 0.5 to 6 Hz which results in the type of distortion that may be perceived as a fluctuation of pitch.

3.18 Zero Tape Signal Level

The residual signal (noise) level on blank recording tape. For the purpose of this standard, zero tape signal level exists on previously unrecorded tape.

4. REQUIREMENTS

4.1 Minimum Performance

The tape recorder performance shall meet or exceed the requirement for each characteristic as given below and listed in table 1. The table also gives the section numbers where the performance requirement and the test method for each requirement can be found. For some performance requirements, the appropriate test method is sufficiently obvious and easy to perform that a formal test method has not been supplied.

4.2 User Information

A nominal value for each of the characteristics listed in table 1 which have numerical values shall be included in the information supplied to the user by the manufacturer or distributor. In addition, the manufacturer shall indicate whether or not the tape recorder has automatic gain control, a voice-actuated capability, and whether any channels are used as time code channels. The manufacturer shall also supply instructions for cleaning and maintaining the tape recorder.

TABLE 1. *Summary of performance requirements for voice-logging tape recorders*

Characteristic	Requirement	Complete requirement (section #)	Test method (section #)
Electronic			
Input Isolation	Isolated transformer winding	4.3.1	-----
Frequency Response	300 to 3000 Hz with less than 6-dB max-to-min difference	4.3.2	5.4.2
Input Impedance	5100 Ω minimum	4.3.3	5.4.3
Tape Distortion	Less than 3%	4.3.4	5.4.4
Power Amplifier Distortion	Less than 5% while producing at least 1 W into 8 Ω	4.3.5	5.4.5
Input Dynamic Range (for recorders having automatic gain control)	At least 47 dB above the ONV	4.3.6	5.4.6
Adjacent-Channel Crosstalk	At least 32 dB down	4.3.7	5.4.7
Record Input Voltage	0.1 to 4.0-V rms to produce full-recorded level with less than 1% narrow-band noise	4.3.8	5.4.8
Tape Transport			
Tape Speed	Less than 3% variance	4.4.1	5.5.1
Rewind and Fast Forward Time	Less than 2 min for 3600 ft of tape	4.4.2	5.5.2
Tape Protection	No tape spillage or damage to occur under any circumstances	4.4.3	-----
Tape Position Indicator	Relocation error less than 51 cm (20 in)	4.4.4	5.5.3
Weighted Peak Flutter and Wow	Less than 0.5%	4.4.5	5.5.4

4.3 Electronic Characteristics

The tape recorder electronic characteristics of frequency response, input impedance, system distortion, power amplifier distortion, dynamic range, adjacent-channel crosstalk, and record input voltage shall be measured in accordance with section 5.4.

If one of the tape recorder channels is used as a time code channel, this channel is exempt from the requirements of sections 4.3.1 through 4.3.8.

4.3.1 Input Isolation

The tape recorder shall include a signal-coupling transformer in each record input channel, the primary (i.e., input) winding of which shall be floating. Also, a dc blocking capacitor shall be in series with each input winding. The blocking capacitor shall have a working voltage of at least 200 V dc regardless of polarity.

4.3.2 Frequency Response

When each channel is tested individually over the frequency range from 300 to 3000 Hz, there shall be less than a 2:1 voltage ratio (i.e., 6 dB) between the maximum and minimum responses.

4.3.3 Input Impedance

The input impedance of each channel shall be at least 5100 Ω for frequencies between 300 and 3000 Hz.

4.3.4 System Distortion

When measured at the tape recorder audio output jack during playback, a 500-Hz sinewave with a tape signal level of 32 dB above the ONV shall produce a signal whose combined second- and third-harmonic distortion voltage is less than 3 percent true rms.

4.3.5 Power Amplifier Distortion

During playback the tape recorder shall deliver at least 1 W into an 8-Ω resistive load, while producing a signal whose combined second- and third-harmonic distortion voltage is less than 5 percent true rms.

4.3.6 Dynamic Range at Record Input Terminals (Automatic Gain Control Only)

For each channel, a 500-Hz sinewave whose voltage is 27 dB above that required to produce a tape signal level of 20 dB above the ONV shall, when applied to the channel's record input terminals, result in a recording that, upon playback, produces a signal whose combined second- and third-harmonic distortion voltage is less than 3 percent true rms.

4.3.7 Adjacent-Channel Crosstalk

The adjacent-channel crosstalk for any single channel shall be at least 32 dB below the level of a 1000-Hz driving sinewave.

4.3.8 Record Input Voltage

Each channel shall have its own gain control. Any fixed signal input voltage within the range of 0.1 to 4.0 V rms shall be able to produce full-recorded level on the tape with less than 1 percent narrow-band noise, using either automatic gain control circuits or by manual adjustment of internal gain controls.

4.4 Tape Transport Characteristics

The tape speed and reel capacity combination shall be capable of 24 h of continuous operation.

The tape transport characteristics of tape speed, fast forward and rewind, tape position indicator, and weighted peak flutter and wow shall be measured in accordance with section 5.5.

4.4.1 Tape Speed

The tape speed shall be the nominal speed ±3 percent.

4.4.2 Fast Forward and Rewind

The tape recorder fast forward and rewind time shall each be less than 2 min for 1100 m (3600 ft) of tape.

4.4.3 Tape Protection

There shall be no tape spillage, breakage, significant stretching, or other visible tape damage resulting from a power failure or from operation of the recorder's front panel controls in any sequence that is possible. The term "significant stretching" means stretching that weakens the bond of the magnetic coating to the backing or that causes mechanical distortion (usually visible) which prevents the tape from performing satisfactorily.

4.4.4 Tape Position Indicator

If provided, the tape position indicator shall be able to permit repositioning of the tape to within 51 cm (20 in) of its starting point after making a 610-m (2000 ft) round trip [i.e., 305 m (1000 ft) in each direction at the fast forward and rewind speeds].

4.4.5 Weighted Peak Flutter and Wow

The weighted peak flutter and wow shall not exceed 0.5 percent.

5. TEST METHODS

5.1 Test Conditions

Allow all measurement equipment to warm up until the system has achieved sufficient stability to perform the measurement.

5.1.1 Ambient Conditions

The tape recorder shall be tested at a location that is free of mechanical vibration or other ambient conditions that would affect its performance. The ambient temperature shall be between 16 and 32 °C (60 to 90 °F). The actual power line voltage shall be made part of the written test record, but may be anywhere between 105 and 125 V rms. The average power line frequency shall be 60 Hz ±0.5 percent for 10-s averaging.

5.1.2 Routine Operation and Maintenance

Test personnel shall become familiar with the controls and operation of the recorder prior to testing. Cleaning the tape heads and guides, degaussing the tape heads, and any other routine maintenance shall be performed in accordance with the instructions of the manufacturer.

5.1.3 Presetting of Controls

All internal adjustments of the tape recorder such as gain of input channels and tape bias voltage shall be made before the series of tests begins. If adjustments are made during the course of the tests, then the entire set of tests shall be repeated, except for section 5.4.8, Record Input Voltage Test. If the recorder is capable of voice-actuated recording, this feature shall be disabled prior to testing. If the recorder provides a choice of record input voltage ranges, the highest voltage range shall be used.

5.1.4 Tape Selection

The tests shall be made using new tape of a type that is recommended by the tape recorder manufacturer. Because the results of the first tests (sec. 5.4.1, Reference Signal Level Tests) are used as reference points for other measurements and are influenced by the recording tape, the same reel of tape must be used for the entire series of tests described in sections 5.4.1 through 5.5.2.

5.1.5 Special Considerations

Some tape recorders do not provide an indication of the recording level that is present at the tape. For this reason, this standard uses the recorder overall noise voltage as the reference point for the recording level (see sec. 5.4.1, Reference Signal Level Tests).

The flutter and wow produced by these tape recorders is large enough to produce substantial frequency modulation of signals. This causes the pure testing tones to be spread out in frequency and thus makes very narrow-band filters unsuitable. As a consequence, the frequency response of the narrow-band voltmeter (see sec. 5.2.5) must be carefully specified, and some of the characteristics measured are different from those usually tested. For example, tape recorder noise is measured in a 100-Hz wide band centered at 1750 Hz, rather than the customary wide band measurement. Another variation is that only the second- and third-harmonic distortion is measured, rather than the customary total harmonic distortion.

5.2 Test Equipment

The following list describes the principal test equipment needed. Any other test equipment used shall be of comparable quality.

5.2.1 AC Voltmeter (V_1)

This meter shall be accurate to within ±6 percent (i.e., ±0.5 dB) over the frequency range of 300 to 3000 Hz for voltages within the range of 10 mV to 10 V rms. Calibration shall be in terms of rms volts of a sinewave, and the meter may be either true rms or average responding. Its input impedance shall be at least 50,000 Ω.

5.2.2 AC Voltmeter (V_2)

This meter shall be accurate to within ±6 percent (i.e., ±0.5 dB) over the frequency range of 100 to 10,000 Hz for voltages from 7 mV to 4 V rms. The meter shall be true rms responding and shall maintain its accuracy for crest factors up to at least 2.5 at full scale. Its input impedance shall be at least 100,000 Ω and its input shunt capacitance shall be less than 100 pF. It is desirable that this meter have a relatively long time constant (perhaps 0.1 s) and an analog display.

5.2.3 Sinewave Generator

The frequency range of this generator shall be from at least 300 to 3000 Hz, and its frequency calibration error shall be less than 2 percent at 300 and 3000 Hz. Its open circuit output voltage shall be adjustable over the range from 10 mV to 10 V rms, and its output impedance shall be 600 ±60 Ω. The amplitude change with frequency shall be less than ±3 percent (i.e., ±0.25 dB) with respect to its value at 1000 Hz. Neither the second- nor third-harmonic distortion voltages shall exceed 0.3 percent.

5.2.4 Flutter and Wow Meter

This meter shall be capable of measuring weighted peak flutter and wow, as specified by IEEE Standard 193-1971. The measurement error shall be less than 10 percent for values of flutter and wow that are between 0.2 and 0.6 percent.

5.2.5 Narrow-Band Voltmeter

This instrument shall be tunable to center frequencies from 500 to 1750 Hz, and its passband response shall have a 3-dB bandwidth of 100 ±15 Hz and be at least 20 dB down at ±200 Hz from center frequency and be at least 46 dB down at ±500 Hz from center frequency. Its measurement error shall not exceed ±6 percent (i.e., ±0.5 dB) at 30 dB down, and shall not exceed ±12 percent (±1 dB) at 40 dB down.

5.2.6 Noise Filter

The noise filter shall have a response that reaches its maximum at 1600 Hz, and is 3 dB below this at 280 and 7800 Hz. A two-section RC filter with the necessary characteristics is shown in figure 2.

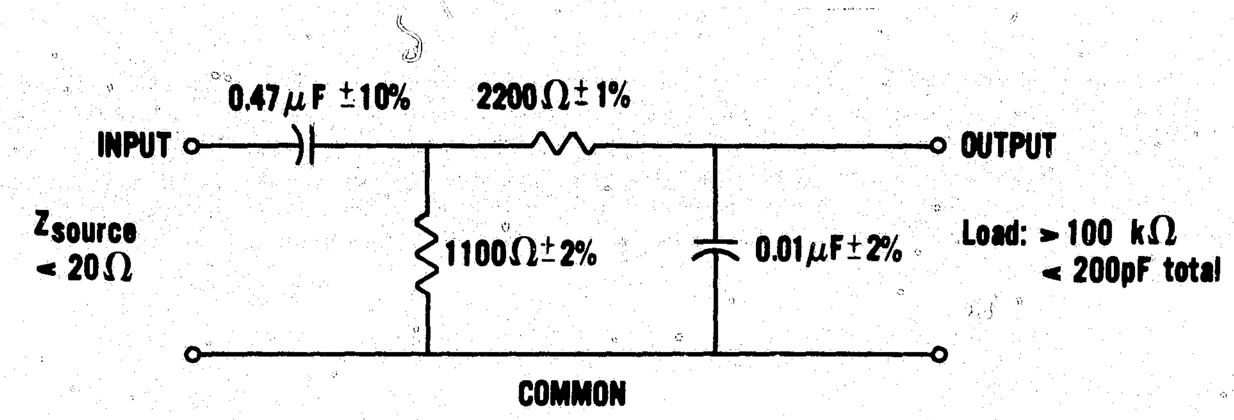

FIGURE 2. *Noise filter circuit diagram.*

5.3 Test Sequence

The tape speed test (sec. 5.5.1) may be performed at any time. Except for this, the reference signal level tests (sec. 5.4.1) must be performed first and the record input voltage test (sec. 5.4.8) last. The otner tests may be performed in any sequence desired.

5.4 Electronic Tests

5.4.1 Reference Signal Level Tests

This procedure determines the proper voltage levels for test signals that will be used in later tests. Specifically, this section determines, for a 500-Hz sinewave test signal, the voltage needed at the tape recorder record input terminals to produce tape signal levels of 26 and 32 dB above the ONV (also 20 dB above the ONV if the recorder has automatic gain control). The voltages measured by voltmeter V_2 are likely to be somewhat erratic, in which case the average reading observed over approximately 5 s shall be reported.

Interconnect the tape recorder and the test equipment as shown in figure 3 with a 620-Ω resistor across the record input terminal pair for each channel and an 8-Ω 10-W resistor across the audio output. Using previously unrecorded tape, start the recorder in its playback mode. Choose one channel for playback and adjust the volume control so that voltmeter V_2 indicates approximately 10 mV rms. Do not change this volume control setting. Write down the voltage shown by voltmeter V_2. This is the overall noise voltage (ONV) of the selected channel.

With the tape recorder continuing in the playback mode, select another channel for testing, and write down the corresponding value of V_2. Repeat this step for each channel.

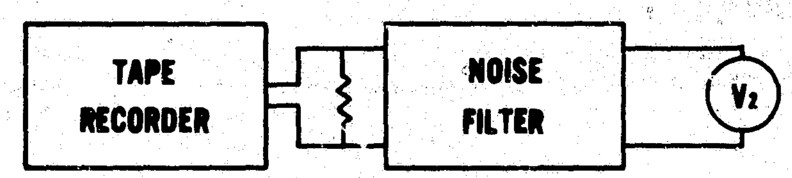

FIGURE 3. *Block diagram for the overall noise voltage measurements.*

Disconnect the 620-Ω resistors and connect the sinewave generator and ac voltmeter to the tape recorder as shown in figure 4. Put the recorder into its record mode so that a 500-Hz signal from the sinewave generator is being recorded on one channel, and monitor the tape playback signal for this channel with voltmeter V_2. Adjust the output (V_1) of the sinewave generator so that voltage V_2 is 20 times (i.e., 26 dB above) the ONV that was measured for this channel previously. Write down the value of V_1. Repeat these steps for each tape recorder channel.

Repeat the above paragraph, except the sinewave generator voltage (V_1) shall be adjusted so that the voltage for each channel at the audio output jack (V_2) is 40 times (i.e., 32 dB above) the ONV for the channel being tested.

If the recorder uses automatic gain control in its record input circuits, an additional test is required. Repeat the previous procedure, except the sinewave generator voltage (V_1) shall be adjusted so that for each channel the voltage at the audio output jack (V_2) is 10 times (i.e., 20 dB above) the ONV for the channel being tested.

If the tape recorder has more than one tape transport, repeat the entire procedure for each transport.

FIGURE 4. *Block diagram for the reference signal level measurements.*

5.4.2 Frequency Response Test

Select one channel to be tested, interconnect the tape recorder and test equipment as shown in figure 5, and connect an 8-Ω 10-W resistor across the audio output. Maintain the sinewave generator output voltage (V_1) at the value, determined in section 5.4.1, that produces a tape signal level of 26 dB for the channel under test. With the sinewave generator at 1000 Hz, start recording this signal and monitor the tape playback signal with voltmeter V_2. Check that only the channel under test is being monitored. Adjust the volume control of the recorder to bring V_2 to any convenient value between 0.1 and 1 V rms. Do not change this control setting. Slowly sweep the sinewave generator frequency from 300 to 3000 Hz and write down the largest and smallest readings shown by voltmeter V_2. Repeat this procedure for each channel.

If the recorder has more than one tape transport, repeat the entire procedure for each transport.

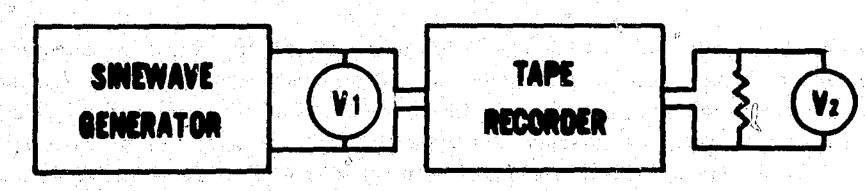

FIGURE 5. *Block diagram for the frequency response measurements.*

5.4.3 Input Impedance Test

Select one input terminal pair to be tested, interconnect the tape recorder and test equipment as shown in figure 6, insure that a 5100-Ω resistor is connected to the channel under test, and set the volume control to zero. With the sinewave generator at approximately 1000 Hz, set its output voltage (V_1) to within 3 dB of the value that produces a tape signal level of 32 dB above the ONV on the channel being tested as determined in section 5.4.1.

With the recorder operating in the record mode, slowly sweep the sinewave generator frequency from 300 to 3000 Hz and locate the minimum value of V_2 within this span. Insure that the minimum value of V_2 is not less than one-half the voltage of V_1 (i.e., not more than 6 dB down).

Repeat this procedure for each channel of the tape recorder.

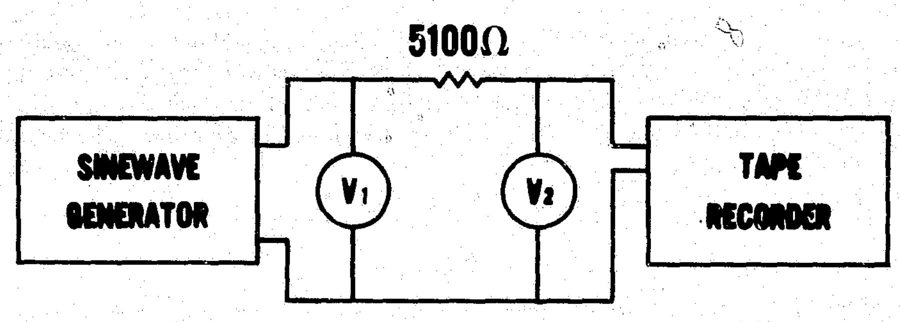

FIGURE 6. *Block diagram for the input impedance measurements.*

5.4.4 System Distortion Test

Select one channel to be tested, interconnect the tape recorder and test equipment as shown in figure 7 and connect an 8-Ω 10-W resistor across the audio output. Set the sinewave generator output to 500 Hz at a voltage that produces a tape signal level of 32 dB above the ONV (sec. 5.4.1). Start recording the test signal, and monitor the tape playback signal with voltmeter V_2. Adjust the volume control to bring V_2 to any convenient value between 0.5 and 1.5 V rms. Write down the value of V_2. Do not change this setting during the remainder of this test. Set the narrow-band voltmeter for a 3-dB bandwidth of 100 Hz and adjust its center frequency so that a maximum response is obtained near 500 Hz. Write down this narrow-band voltmeter reading, V_{h1}, the voltage of the fundamental frequency.

FIGURE 7. *Block diagram for the system distortion, power amplifier distortion, input dynamic range, adjacent-channel crosstalk, and record input voltage measurements.*

With the narrow-band voltmeter still set for a 3-dB bandwidth of 100 Hz, adjust its center frequency so that maximum response is obtained near 1000 Hz. Write down the narrow-band voltmeter reading, V_{h2}, the voltage of the second-harmonic distortion. With the narrow-band voltmeter still set for a 3-dB bandwidth of 100 Hz, adjust its center frequency so that a maximum response is obtained near 1500 Hz. Write down the narrow-band voltmeter reading, V_{h3}, the voltage of the third-harmonic distortion. Calculate the percentage of combined second- and third-harmonic distortion as:

$$\text{Percent Distortion} = \frac{\sqrt{V^2_{h2} + V^2_{h3}}}{V_{h1}} \times 100 \text{ percent;}$$

all voltages are in volts rms.

Repeat this procedure for each record input channel of the tape recorder.

5.4.5 Power Amplifier Distortion Test

Select any convenient channel to serve as the recording and playback channel, interconnect the tape recorder and test equipment as shown in figure 7 and insure that an 8-Ω 10-W resistor is connected across the audio output. Set the sinewave generator output to 500 Hz at the voltage that produces a tape signal level of 26 dB above the ONV (sec. 5.4.1).

Start recording the test signal, and have the tape playback signal from this channel available at the audio output jack. Adjust the volume control so that voltmeter V_2 indicates 2.83±0.1 V rms. Do not change this control setting. Determine V_{h1}, V_{h2}, and V_{h3}, and calculate the percent distortion as described in section 5.4.4.

5.4.6 Input Dynamic Range Test (Recorders with Automatic Gain Control Only)

Select one channel to be tested, interconnect the tape recorder and test equipment as shown in figure 7, and insure that an 8-Ω 10-W resistor is connected across the audio output. Set the sinewave generator output for 500 Hz at a voltage that is 27 dB above that needed to produce a tape signal level of 20 dB above the ONV (sec. 5.4.1). Start recording the test signal and monitor the tape playback signal with voltmeter V_2. Adjust the volume control to bring V_2 to any convenient value between 0.5 and 1.5 V rms. Do not change this setting during the remainder of this test. Write down the value of V_2. Determine V_{h1}, V_{h2}, and V_{h3}, and calculate the percent distortion as described in section 5.4.4.

Repeat this procedure for each record input channel of the tape recorder.

5.4.7 Adjacent-Channel Crosstalk Test

Interconnect the tape recorder and test equipment as shown in figure 7 with an 8-Ω 10-W resistor across the audio output. Connect the sinewave generator to a channel whose recording track is at or near the center of the tape. Insure that no signal is applied to any other channel, and place separate 620-Ω resistors across the input terminals of each of the two channels whose tracks are immediately adjacent to the recording channel. Set the sinewave generator to 1000 Hz at the voltage that produces a tape signal level of 32 dB above the ONV for this channel (sec. 5.4.1). Record the test signal for about 3 min and then rewind the tape to the beginning of this recording.

With the recorded channel selected for playback, start the recorder in the playback mode and then adjust its volume control so that voltmeter V_2 indicates a voltage between 0.5 and 2.0 V rms. Do not change the volume setting for the remainder of this test. Set the narrow-band voltmeter for a 3-dB bandwidth of 100 Hz, and adjust its center frequency so that a maximum response is obtained near 1000 Hz.

While the recorder continues in the playback mode, switch output connections from the recorded channel to one of the adjacent channels. Insure that the recorded section of tape is being played back and write down the voltage V_a, indicated by the narrow-band voltmeter. Without changing the frequency control settings of the sinewave generator or the narrow-band voltmeter, move the sinewave generator and voltmeter V_1 to the record input terminals of the adjacent channel selected for playback. Set the sinewave generator to the voltage that produces a tape signal level of 32 dB above the ONV (sec. 5.4.1) for this channel. Record this signal while also monitoring its playback with the narrow-band voltmeter. Write down the value of this playback voltage, V_b. The adjacent-channel crosstalk is equal to

$$\left[20 \log_{10} \frac{V_b}{V_a}\right] \text{dB.}$$

5.4.8 Record Input Voltage Test

This test must be performed last because it requires changing the settings of some internal controls in the recorder. It is conducted to verify that, for any chosen input level between 0.1 and 4 V rms, the recorder's internal record input gain controls can be set to record the signal at full recorded level.

Interconnect the tape recorder and the test equipment as shown in figure 7. Connect the sinewave generator to a channel arbitrarily selected for test, and select the tape playback signal of this channel only to appear at the audio output jack of the recorder.

Set the internal record input gain control of the chosen channel so that an input signal of 0.1 V rms can be expected to produce a strong but nonsaturating recorded signal. Set the signal generator to 500 Hz and 0.1 V rms as read by voltmeter V_1. Operate the tape recorder in its record mode and adjust the volume control so that V_2 indicates any convenient value between 0.5 and 1.5 V rms. Using the narrow-band voltmeter with its 3-dB bandwidth set to 100 Hz, write down the voltage readings obtained for center frequencies of 500, 1000, 1500, and 1750 Hz. Label these voltages V_{h1}, V_{h2}, V_{h3}, and V_n, respectively. Calculate the percent distortion as described in section 5.4.4 and the narrow-band noise as follows:

$$\text{Narrow-band Noise} = \frac{V_n}{V_{h1}} \times 100 \text{ percent}$$

If the channel did not pass this test, repeat the above procedure, trying other settings of the record input gain control, until it does pass or until it becomes clear that the channel is unable to pass the test.

Repeat the entire above procedure for an internal record input gain control setting such that a 4 V rms input produces a strong but undistorted recorded signal. If the channel does not pass the test, try other settings of the internal record input gain control until it does pass or until it becomes clear that the channel is unable to pass the test.

5.5 Tape Transport Tests

5.5.1 Tape Speed Test

This test measures tape speed by using a manually operated stopwatch to measure the time required for 91.4 cm (36 in) of recording tape to pass a reference point on the tape recorder.

At any convenient location within the first 30.5 m (100 ft) of recording tape, produce a reference length of tape by making two marks 91.4±0.5 cm (36±3/16 in) apart using a device such as a fiber point pen having a permanent ink. Choose a convenient point on the tape deck along the tape path between the tape reels for use as a visual reference point. The marks mentioned above should be made on whichever side of the tape makes them most easy to compare with the reference point.

Wind the 91.4-cm (36 in) length onto the supply reel, zero the stopwatch and start the recorder in its playback mode. Start the stopwatch, when the leading mark on the tape reaches the chosen reference point on the recorder. Stop the stopwatch when the trailing mark reaches the reference point. For a nominal speed of 1.19 cm/s (15/32 in/s), the recorder passes this test if the 91.4 cm (36 in) of tape took 76.8±2.3 s to pass the reference point.

Repeat the above procedure using the last 30.5 m (100 ft) of tape on the supply reel.

5.5.2 Fast Forward and Rewind Tests

Load an 1100-m (3600 ft) test tape on the tape transport. Measure the time required to run this amount of tape through the recorder in the fast forward mode. Reset the tape recorder to rewind, and measure the time required to run this amount of tape through the recorder in the rewind mode.

5.5.3 Tape Position Indicator Test

Load a test tape, at least 366 m (1200 ft) in length, on the tape transport and make a suitable visible mark at a convenient starting point on the tape. Record the tape position indicator reading. Set the recorder to fast forward and run at least 305 m (1000 ft) of tape through the machine. Reset the recorder to rewind and return the tape to its starting position. Make a visible mark on the tape and measure the distance between this mark and the one made earlier.

5.5.4 Weighted Peak Flutter and Wow Test[2]

Interconnect the tape recorder and test equipment as shown in figure 8. Connect the sinewave generator to any channel except the two whose track positions are nearest the edges of the recording tape. Set the sinewave generator to 3050 Hz at the voltage which produces a tape signal level of 32 dB (sec. 5.4.1) for the chosen channel. Use either the rewind or the fast forward control to move the tape so that less than 10 percent of the tape length remains on the supply reel. Record the 3050-Hz signal for about 2 min and then rewind the tape to the beginning of the recording.

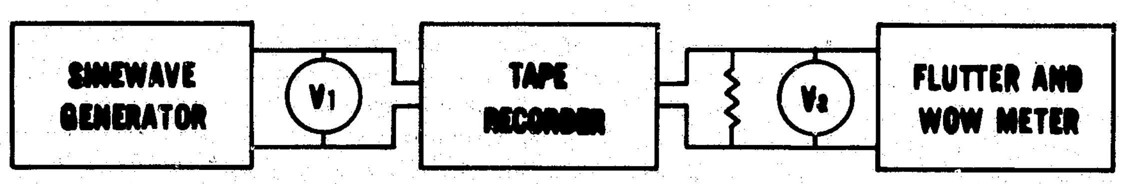

FIGURE 8. *Block diagram for the weighted peak flutter and wow measurements.*

[2] Weighted peak flutter and wow measurements are made in a manner similar to unweighted flutter and wow measurements except that the 0.5- to 100-Hz band of frequencies is passed through a specified weighting filter before being rectified, the rectifier output is the peak-to-peak value of its input and the time response of the indicating meter/circuit must meet specified requirements, such as the 5-s response specified in this standard.

Select the recorded channel for playback and start the recorder in the playback mode. Set the volume control of the tape recorder to produce a reading of about 1 V rms on voltmeter V_2 and then use the flutter and wow meter to measure the weighted peak flutter and wow. The flutter and wow is the average value, over a 5-s interval, of the flutter and wow meter readings.

National Institute of Justice
James K. Stewart
Director

END