SMPTE ENGINEERING GUIDELINE

EG 16-1992
Revision of EG 16-1987

Measurement Methods for Motion-Picture Camera Acoustical Noise — Field Method

1 Scope and field of application

1.1 This guideline provides a simple method for measuring the acoustical noise output of motion-picture cameras in use on the set of a production. The guideline applies to noise occurring in only one circumstance: in front of a given camera in a specific acoustical environment. Thus, the measurements given by this guideline are not comparable with others made in different situations.

1.2 This guideline also gives limits on acceptability of measured camera noise due to the combined effects of the camera and its environment. Methods for reducing camera noise which are practicable on the set are included.

2 Normative reference

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

IEC 651 (1979), Sound Level Meters

3 Definitions

For the purpose of this guideline, the following definitions apply:

3.1 **sound pressure level, L_p, in decibels:** Twenty times the logarithm to the base 10 of the ratio of the sound pressure to the reference sound pressure. The frequency weighting network used shall be indicated; for example, A-weighted sound pressure level, L_{pA}. The reference sound pressure is 20 µPa.

3.2 **reference point:** The center of the film aperture in the camera gate.

3.3 **measurement distance:** The distance between the reference point and the measurement point.

3.4 **background noise:** The A-weighted sound pressure level at the microphone position with the camera inoperative.

4 Acoustical environment

4.1 Criteria for adequacy of the test environment

Ideally, the test environment should be free from reflecting objects other than a single reflecting plane so that the source radiates into a free field over a reflecting plane. In practice, measurement to this guideline shows the effects of the environment. No environmental correction factor is applied in order to keep the measurement simple, but users are cautioned that the results are not directly comparable from one situation to another.

4.2 Criterion for background noise

At the microphone positions, the A-weighted sound pressure level due to the background noise shall be at least 3 dB below the A-weighted sound pressure level with the source operating. (Background noise levels which are less than 3 dB below the sound level of the source to be measured are too high for the purposes of this guideline. Under such circumstances, it is not possible to determine the A-weighted sound pressure level of the source to reasonable accuracy. However, the result determined with higher background noise levels may be useful as an indication of the upper limit of the sound pressure level of the source.)

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5 Instrumentation

5.1 General

A sound level meter that meets the requirements of IEC 651 shall be used switched to the "impulse" characteristic.

To minimize the influence of the observer on the measurements, a cable should preferably be used between the microphone and the sound level meter. The observer shall not stand between the microphone and the source whose sound pressure level is being measured.

5.2 Calibration

At least before each series of measurements, an acoustical calibrator with an accuracy of ± 0.5 dB shall be applied to the microphone for calibration of the entire measuring system, including cable, if used, at one or more frequencies. One calibration frequency shall be in the range of 250 Hz to 1000 Hz. The calibrator shall be checked annually to verify that its output has not changed.

6 Camera installation and operation

6.1 General

The camera to be tested shall be installed and mounted with respect to the reflecting plane in the position that is representative of normal use. The camera shall be provided with all noise-control means normally employed, such as any blimp, barney, or optical clear-glass filters in front of the lens.

6.2 Auxiliary equipment

Care shall be taken to ensure that any auxiliary equipment does not radiate significant amounts of sound energy in the test environment in conformity with 4.2. If practicable, all auxiliary equipment necessary for the operation of the device under test shall be located outside of, or acoustically isolated from, the test environment.

6.3 Operation of the camera during tests

During the acoustical measurements, the source shall be operated as follows:

- with a film load at least similar to the film stock to be used;

- with each phase of perforation engagement, to produce maximum noise by trying each relative engagement between the film and the sprocket teeth in the camera, moving one perforation at a time;

- with the lens to be used;

- at each angle that the camera is to be tilted or panned, to find the point of maximum noise.

7 Measurement of frequency and time-weighted sound pressure level

7.1 Meter

Measure the A-weighted sound pressure level with the sound level meter set to impulse responding.

7.2 Measurements

All sound level measurements are made at a distance of 1 meter from the reference points, along lines which extend forward (toward the intended subject) from the reference point.

7.2.1 Make the primary measurement along a line extending 45° upward from the reference point and parallel to the lens axis (see figure 1).

7.2.2 Make four secondary measurements: Make one secondary measurement on the lens axis. Make one measurement on a line extending 45° to the right of the reference point and one measurement on a line extending 45° to the left of the reference point, both parallel to the reflecting plane. Make one measurement on a line extending 45° downward from the reference point and parallel to the lens axis (see figure 1).

7.3 Corrections for background noise

The sound pressure levels recorded at each of the microphone positions shall be corrected for the influence of background noise according to table 1.

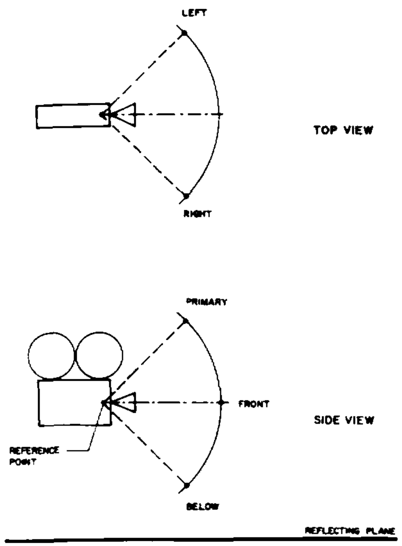

Figure 1 – Measurement locations

Table 1 – Background noise correction

Difference between sound pressure level measured with sound source operating and background sound pressure level alone	Corrections to be subtracted from sound pressure level measured with sound source operating to obtain sound pressure level due to sound source alone
dB	dB
3	3
4	2
5	2
6	1
7	1
8	1
9	0.5
10	0.5
>10	0.0

8 Limit on acceptability

Limit on acceptability shall be in accordance with table 2.

Table 2 – Limit on acceptability

Situation	Maximum permissible sound pressure level, L_{pA}, impulse reading
Quiet dialogue scene in close up	25
Medium shot of two or more actors at average level	30
Maximum above which ordinary shooting becomes impaired	33

9 Means for reducing camera noise

9.1 Limit the source noise by:

– using blimps, barneys, and/or the addition of an extra optical clear-glass filter in front of the lens or, in the worst cases, sound rooms with optically clear glass;

– choosing the threading phase for lowest noise, that is, engage each perforation of the film in turn, advancing one perforation on each test, to find the lowest noise;

– minimizing lens radiation by choice of lens;

– eliminating vibration induced into tripod or floor by use of resilient mounting.

9.2 Reduce the effective noise by:

– making the environment less reverberant by adding acoustical absorption;

– moving the camera away from the actor(s) and microphone(s).

9.3 Pick up less of the camera noise by microphone techniques:

– use directional microphones, pointing the lowest sensitivity direction of the microphone at the camera, and the highest sensitivity direction at the actor(s);

– position the microphone as close to the source and as far from the camera as practical.

Annex A (informative)
Background

A.1 This guideline started with a request that the Subcommittee on Audio Production and Post-Production for Motion-Picture and Television Entertainment Programming study the question of making a noise measurement of motion-picture camera noise in a practical way on a motion-picture set. Since neither a simple method nor a more precise one needed by manufacturers to rate camera noise existed, this work was undertaken.

A.2 Since measuring sound pressure level at a single point does not adequately characterize the noise of machinery, which may show strong spatial characteristics, reporting sound power level has been adopted in the art for adequate precision in comparing results of different tests (see, for example, ISO 3741-3746). But even the simplest measurement of sound power level is time consuming, requiring mathematical manipulation for spatial averaging, environmental reflections, background noise, and source size.

A.3 This guideline thus standardizes only the measurement positions and type of instrument to be used, with a simple correction for background noise. In addition, it gives advice on how to measure a camera spatially, so that the user can determine whether a full sound power test would reveal markedly different results.

A.4 The importance of camera noise varies greatly from scene to scene and set to set. Often, other noises on the set mask the camera noise, but in quietly played scenes on quiet sets camera noise can be the most obtrusive noise source. For this reason, a table of acceptability has been included.

Annex B (informative)
Bibliography

ISO 3741:1988, Acoustics — Determination of Sound Power Levels of Noise Sources — Precision Methods for Broad-Band Sources in Reverberation Rooms

ISO 3742:1988, Acoustics — Determination of Sound Power Levels of Noise Sources — Precision Methods for Discrete-Frequency and Narrow-Band Sources in Reverberation Rooms

ISO 3743:1988, Acoustics — Determination of Sound Power Levels of Noise Sources — Engineering Methods for Special Reverberation Test Rooms

ISO 3744:1981, Acoustics — Determination of Sound Power Levels of Noise Sources — Engineering Methods for Free-Field Conditions Over a Reflecting Plane

ISO 3745:1977, Acoustics — Determination of Sound Power Levels of Noise Sources — Precision Methods for Anechoic and Semi-anechoic Rooms

ISO 3746:1979, Acoustics — Determination of Sound Power Levels of Noise Sources — Survey Method

SMPTE ENGINEERING GUIDELINE

EG 17-1992
Revision of EG 17-1987

B-Chain Electroacoustical Response for Preparing Magnetic Masters for Transfer to 16-mm or 35/32-mm Monaural Photographic Film

1 Scope

This guideline specifies the electroacoustical frequency response characteristic of the monitor system when making magnetic masters intended for transfer to 16-mm photographic negative tracks.

2 Definitions

2.1 complete sound reproduction system: Represented diagramatically in figure 1 and used in studio dubbing theaters, laboratory review rooms, and indoor theaters, generally considered to consist of an A- and B-chain.

2.2 preemphasized audio track: An audio record, either magnetic or photographic, which is intended for playback over normally deemphasized playback systems.

2.3 A-chain (transducer system): That part of a motion-picture audio system shown in figure 1, extending from the transducer to the input terminals of the main fader.

2.4 B-chain (final chain): That part of a motion-picture sound reproduction system shown in figure 1, commencing from the input terminals of the main fader and terminating at any position in the listening area of the room or auditorium at which sound-pressure measurements are taken.

2.5 electroacoustical response: The electroacoustical response of the final chain is the sound-pressure level expressed in decibels with respect to an arbitrary reference pressure over a given frequency range measured at a given position in the listening area when wide-band pink noise is applied to the input terminals of the main fader.

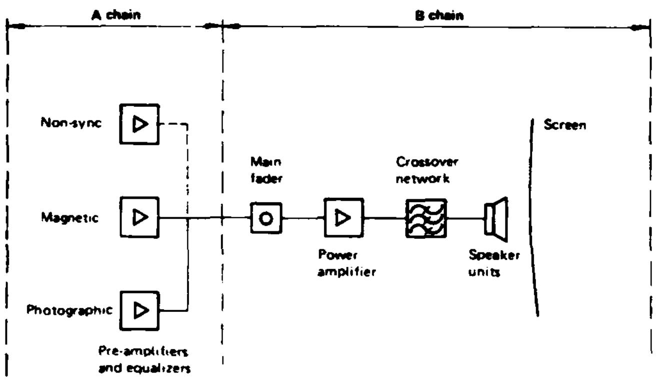

Figure 1 – Complete theatrical sound reproducing system

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2.6 wide-band pink noise: A continuous spectrum noise having constant energy per constant percentage bandwidth and Gaussian probability distribution of instantaneous values, having a bandwidth exceeding the frequency range of interest (typically extending from 31.5 Hz to 12.5 kHz).

3 Method of measurement

3.1 The electroacoustical response shall be measured by generating wide-band pink noise on the monitor at a level of 85 dBC, slow reading. Measure the acoustical output with a calibrated microphone intended for use in the diffuse field together with an audio-frequency real-time spectrum analyzer, covering the spectrum in 1/3-octave bands.

3.2 The electroacoustical response shall be an average of the response measured according to 3.1 at an adequate number of locations in the room where monitoring occurs.

4 Characteristic

4.1 For record monitoring, where magnetic masters are being prepared with preemphasis for making photographic negatives, both the photographic A-chain and the B-chain deemphasis in the monitoring chain are required as shown in table 1 and figure 2.

4.2 Because of the room gain reverberation component and high-frequency attenuation in air (proportional to the signal patch length), the measured frequency response should have a slightly elevated high-frequency response in a small dubbing theater. Table 2 gives approximate correction factors which should be added numerically to the characteristic curve in table 1 and figure 2.

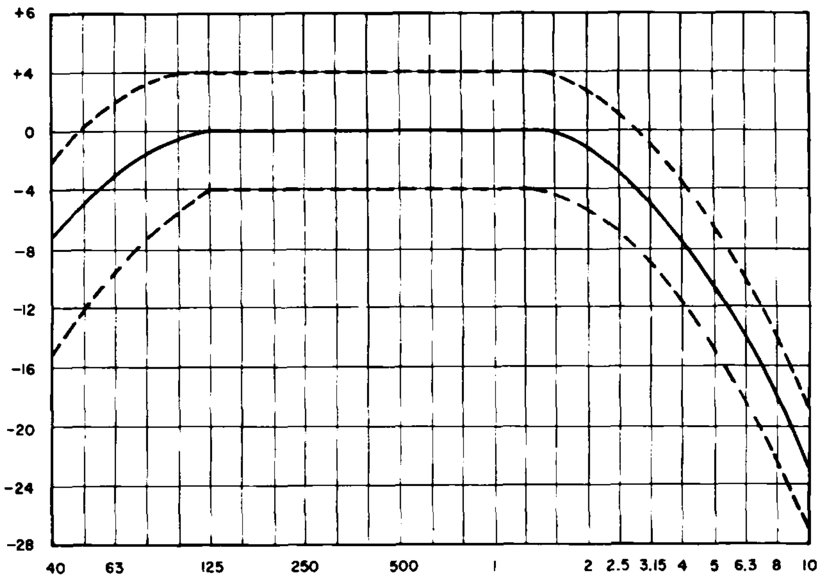

Figure 2 – A- + B-chain characteristic

Table 1 – A- + B-chain electroacoustical response (dB)

Frequency	Preemphasized audio track	Tolerance + dB	Tolerance − dB
40	− 7.0	5	8
63	− 3.0	5	7
125	0	4	4
250	0	4	4
500	0	4	4
1000	0	4	4
2000	− 1.0	4	4
2500	− 3.0	4	4
3150	− 5.0	4	4
4000	− 7.5	4	4
5000	−10.5	4	4
6300	−14.0	4	4
7100	−16.0	4	4
8000	−18.0	4	4
9000	−20.5	4	4
10000	−23.0	4	4

Table 2 – Approximate correction factors for auditorium size, dB

Frequency	Number of seats						
	10	30	150	500	1000	1500	2000
2000	0	0	0	0	0	0	0
4000	1.5	1.0	0.5	0	−0.5	−1.0	−1.5
8000	3.0	2.0	1.0	0	−1.0	−2.0	−3.0

NOTE – For conversion to room volume in cubic feet, a figure of 190 ft^3/seat, the average of many U.S. theaters, may be used.

Annex A (informative)
Additional data

This guideline is not intended to provide a standard for the playback characteristics of the photographic track, due to the fact that 16-mm film is used in such varied facilities. Such screenings are in classrooms where the internal speaker of the projector is used and the sound track has to compete with the projector noise; in churches where the acoustics are often a compromise; in television receivers where the speaker in the TV set has its limitations; or in small screening theaters. It has been found in practice that when using the standard Academy monitor characteristic (as described in this guideline) for preparing monaural masters for photographic tracks, a good quality track is obtained for virtually all screening situations. Generally, 16-mm projectors have manual tone controls which may be adjusted according to the acoustical conditions of the screening. Under good screening conditions, a center positioning of the tone controls will produce a good-sounding track.

It is recommended that a 6- or 7-kHz low-pass filter and a 70-Hz high-pass filter be inserted during the transfer from magnetic film to 16-mm photographic negative to reduce the effects of cross-modulation distortion.

Annex B (informative)
Bibliography

ANSI S1.11-1986, Specifications for Octave-Band and Fractional Octave-Band Analog and Digital Filters

ANSI S1.13-1971 (R1986), Methods for the Measurement of Sound Pressure Levels

ANSI/SMPTE 202M-1991, Motion Pictures — B-Chain Electroacoustic Response — Dubbing Theaters, Review Rooms and Indoor Theaters

ANSI/SMPTE 214M-1984, Motion-Picture Film (35-mm) —Photographic Audio Reproduction Characteristic

PROPOSED SMPTE RECOMMENDED PRACTICE

RP 78
Revision of RP 78-1983

Specifications for Azimuth Test Film for 16-mm Audio Projectors, Magnetic Type

1 Scope

This practice specifies a test film for use in aligning the azimuth of magnetic head gaps in 16-mm motion-picture audio projectors operating at approximately 36 ft (11 m) per minute.

2 Normative references

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

ANSI S4.3-1982 (R1992), Method for Measurement of Weighted Peak Flutter of Sound Recording and Reproducing Equipment

ANSI S4.6-1982, Method of Measuring Recorded Flux of Magnetic Sound Records at Medium Wavelengths

ANSI/SMPTE 97-1989, Motion-Picture Film (16-mm) — 200-Mil Edge-Position Magnetic Audio Record

ANSI/SMPTE 109-1986, Motion-Picture Film (16-mm) — Perforated 1R

ANSI/SMPTE 223M-1991, Motion-Picture Film — Safety Film

3 Test film signal

3.1 Frequency

The audio record shall be an original recording which will reproduce at a frequency of 7000 Hz ± 100 Hz when the linear speed of the film is 24 perforations per second or approximately 36 ft per minute (7.2 in or 183 mm per second).

3.2 Distortion

The total harmonic distortion of the recorded signals shall not exceed 0.5%.

3.3 Audio record

The audio record shall be recorded so that it extends from the perforations on one side of the film to the opposite edge, or from one edge of the film to the other.

3.4 Recorded level

The azimuth test tone shall not be more than 10 dB down from the equivalent reference level of 400 Hz at 185 nanowebers per meter after correct equalization of 70 µs.

3.5 Flutter

The weighted peak flutter of the audio record shall not exceed ± 0.1% when measured in accordance with ANSI S4.3-1982.

3.6 Azimuth

The azimuth of the audio record shall be 90° ± 3' to the reference edge of the film.

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4 Film stock

4.1 The film stock shall be full-coat, splice-free, and of the low-shrinkage, safety type in compliance with ANSI/SMPTE 223M-1991.

4.2 Test films shall be made on a base cut and perforated in accordance with short-pitch dimensions specified in ANSI/SMPTE 109-1986.

4.3 The film stock shall be conditioned for 10 days at 20°C ± 3°C (68°F ± 5.4°F) at a relative humidity of (50 ± 10)% prior to recording.

4.4 The film shall be recorded and packaged within the temperature and humidity limits specified in 4.3. The recorded film shall be packaged in a metal can and sealed either with a low-moisture permeability plastic tape or a fabric tape having a moisture barrier.

5 Identification

Each test film shall be identified by a suitable identification marking.

6 Calibration

6.1 Flux

The short circuit flux shall be determined by means of the calibrated short-gap ferromagnetic core reproducer technique. This technique is described in ANSI S4.6-1982.

6.2 Level

The signal level specified in 3.4 shall be measured with an rms voltmeter calibrated in decibels with an accuracy of ± 0.1 dB over the bandwidth 31.5 Hz to 16 kHz.

6.3 Reproducing head

The test film shall be calibrated on a reproducing head made in accordance with ANSI/SMPTE 97-1989.

NOTE – A test film made in accordance with this practice is available from the Society of Motion Picture and Television Engineers.

PROPOSED SMPTE RECOMMENDED PRACTICE

Specifications for Audio Level and Multifrequency Test Film for 70-mm Striped Six-Track Release Print Audio Reproducers, Magnetic Type

RP 128
Revision of RP 128-1985

1 Scope

This practice specifies an audio frequency test film to be used for adjusting the sensitivity and frequency response of 70-mm striped six-track motion-picture magnetic audio reproducers intended for release prints operating at 120 perforations per second or approximately 112 ft (34 m) per minute.

2 Normative references

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

ANSI S4.3-1982 (R1992), Method for Measurement of Weighted Peak Flutter of Sound Recording and Reproducing Equipment

ANSI S4.6-1982, Method of Measuring Recorded Flux of Magnetic Sound Records at Medium Wavelengths

ANSI/SMPTE 119-1988, Motion-Picture Film (70-mm) — Perforated 65-mm, KS-1870

ANSI/SMPTE 185-1987, Motion-Picture Film (70-mm) — Position, Dimensions and Reproducing Speed — Six Magnetic Records on Release Prints

ANSI/SMPTE 223M-1991, Motion-Picture Film — Safety Film

3 Test film signal

3.1 Frequencies

The audio record on the film shall be a recording which will reproduce at the frequencies specified in clause 4 when the linear speed of the film is 120 perforations per second or approximately 112 ft (34 m) per minute (22.4 in [56.9 cm] per second).

3.2 Distortion

The total harmonic distortion of the recorded reference signal shall not exceed 0.2%. (See 6.1.)

3.3 Audio record

The audio record shall be recorded in accordance with ANSI/SMPTE 185-1987.

3.4 Signal fluctuations

The signal levels shall not fluctuate more than ± 0.5 dB within each test section length.

3.5 Flutter

The weighted peak flutter of the audio record shall not exceed ± 0.04% when measured in accordance with ANSI S4.3-1982.

3.6 Azimuth

The azimuth of the audio records shall be 90° ± 3′ to the reference edge of the film.

3.7 Signal identification

Each test section and segment shall be preceded by voice announcements identifying the content at a level

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whose peak value does not exceed the peak level of the frequency series.

4 Film stock

4.1 The film stock shall be splice-free and of the low-shrinkage, safety type in compliance with ANSI/SMPTE 223M-1991, and striped in accordance with ANSI/SMPTE 185-1987, unless full-coat stock is used.

4.1.1 Test films shall be made on a base cut and perforated in accordance with dimensions specified in ANSI/SMPTE 119-1988. Test materials made on acetate shall be clearly marked with a usage date.

4.2 The film stock shall be conditioned for 10 days at 20°C ± 3°C (68°F ± 5.4°F) at a relative humidity of (50 ± 10)% prior to recording.

4.3 The film shall be recorded and packaged within the temperature and humidity limits specified in 4.2. The recorded film shall be packaged in a metal can and sealed either with a low-moisture permeability plastic tape or a fabric tape having a moisture barrier.

5 Identification

Each test film shall be suitably identified to include the date of manufacture.

6 Test section

6.1 Reference level

A sine wave with a frequency of 1000 Hz ± 2% shall be recorded ahead of the azimuth section, having an absolute short circuit recorded level of 185 nWb/m ± 10 nWb/m for a duration of approximately 30 seconds.

6.2 Azimuth

A frequency of 16 kHz ± 2% shall be recorded ahead of the pink noise section having an absolute short circuit recorded level of 25.86 nWb/m ± 10 nWb/m for a duration of approximately 30 seconds.

6.3 Pink noise

The pink noise test signal used for this section shall have equal energy in equal logarithmic frequency intervals within the audio bandwidth. The lower limit shall correspond to the lower bandwidth of a 31.5 Hz-octave band filter of the ANSI class II type, and the upper limit to the upper bandwidth of a 16 kHz-octave band filter of the ANSI class II type. (Test bandwidths must be within these limits). The level in each one-third octave band from 40 Hz to 12.5 kHz shall be the same within ± 1 dB. The pink noise signal shall be recorded so that there shall be a low statistical probability of the extreme peaks within the signal saturating the magnetic film. The peak level of the wide band pink noise spectrum shall be essentially equal to that of the corresponding frequency response test segments. The recorded pink noise shall have the characteristic specified in 6.5 and a duration of approximately 30 seconds. (The pink noise test may also be used for multitrack azimuth adjustment using an oscilloscope lissajous figure from the two outside prime tracks of multitrack equipment.)

6.4 Frequency response

The 1000-Hz frequencies of this multifrequency section shall be recorded 6 dB below (92.50 nWb/m) the 185 nWb/m reference. The following test segment frequencies in hertz ± 2% shall be sine waves recorded in the order given:

1000, 31.5, 40, 63, 125, 250, 500, 1000,
2000, 4000, 6300, 8000, 10 000, 12 500,
14 000, 16 000, 1000.

6.5 Recorded levels

With a constant-amplitude sine-wave signal applied to the input of the recording system, the relative characteristic in effective values of the short circuit magnetic flux versus frequency shall decrease with increasing frequency proportionately to the impedance of a parallel combination of a capacitance and a resistance having a time constant of τ = 35 μs and 3180 μs. (A time constant is a shorthand notation, such as illustrated by a frequency response curve, having a shape which results from a time constant of one or more microseconds. This is a convenient way of defining a response curve and is never intended as a recommended electrical circuit.)

The characteristic defined above is obtained by the following calculation:

$$L_\Phi = C_0 - 10\log_{10}\left(\frac{1 + (2\pi\tau_h)^2 f^2}{1 + 1/[(2\pi\tau_l)^2 f^2]}\right)$$

where L_Φ is the recorded relative short circuit magnetic flux level in decibels, f is the frequency in hertz for which L_Φ is computed, τ_l is a time constant of 3180 µs, τ_h is a time constant of 35 µs, and C_0 is a constant with a value of 0.194 calculated to make L_Φ = 0 at the reference frequency of 1000 Hz. The approximate numerical values are given in table 1.

Table 1 – Flux levels versus frequency in nanowebers per meter and decibels

Frequency, Hz f	Short circuit flux* nWb/m	Relative level† L_Φ
1000	92.50	0
31.5	177.68	+ 5.67
40	133.86	+ 4.29
63	120.82	+ 2.32
125	101.89	+ 0.84
250	96.30	+ 0.35
500	94.55	+ 0.19
1000	92.50	0
2000	86.62	- 0.57
4000	71.06	- 2.29
6300	55.35	- 4.46
8000	46.73	- 5.93
10 000	39.14	- 7.47
12 500	32.33	- 9.13
14 000	29.22	-10.01
16 000	25.86	-11.07
1000	92.50	0

* Calculated using the equation $\Phi = 92.50 \times \text{antilog}_{10}(L_\Phi/20)$.
† Calculated using the equation given in 6.5.

6.6 Flux level variation

The film flux level at each frequency from 31.5 Hz through 16 kHz shall be within ± 0.5 dB of the value specified in 6.5. (See table 1.)

6.7 Duration

The duration of frequency response test segments shall be approximately 10 seconds, except for the 16-kHz tone which shall be approximately 30 seconds for azimuth and high-frequency equalization adjustments.

7 Calibration

7.1 Flux

The short circuit flux on the test film shall be determined by means of the calibrated short-gap ferromagnetic core reproducer technique. This technique is described in ANSI S4.6-1982.

7.2 Level

The signal level specified in 3.4 shall be measured with an rms voltmeter calibrated in decibels with an accuracy of ± 0.1 dB over the bandwidth 31.5 Hz to 16 kHz.

7.3 Method

The test film shall be calibrated on a reproducing head made in accordance with ANSI/SMPTE 185-1987.

NOTE – It has been shown that a straight 35 µs curve should be used for maximum use of the magnetic medium. It is recognized, however, that it is necessary for the immediate future to continue to add 3180 µs because some theater equipment is unable to compensate for the low end.

PROPOSED SMPTE RECOMMENDED PRACTICE

for television —

System Service Messages

1 Scope

This practice details and defines the control message subset for the system service level. System service messages are used to perform system functions within a general-purpose communications channel of an interface system. This interface system shall transport data and digital control signals between equipment utilized in the production, post-production, and/or transmission of visual and aural information.

2 Notation

This practice describes the coding of keywords and information fields (I/F) in the form shown below.

NN	KEYWORD or I/F NAME	Keyword or I/F descriptive text	
[The coding NN represents the assigned Keyword or I/F code in hexadecimal format]		["trib-" Descriptive text: effect of message at tributary.] ["bc-" Descriptive text: effect of message at bus controller.] [Other comments ...]	
	Format:	<COMMAND>	
		<PARAMETER NAME 0>	[Parameter description;
		...	Parameter value coding, scale or range;
		<PARAMETER NAME n>	Parameter definitions and explanations]

In the practices listed in annex B, keywords are listed numerically in hexadecimal notation. Keyword numbers are reserved as follows:

— Keywords 00_h – $1F_h$: System service subset
— Keywords 20_h – $3F_h$: Common message subset
— Keywords 40_h – FF_h: Virtual machine type-specifc subset

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3 Summary of keywords, mnemonics and information field (I/F) names

Hex	Keyword	(mnemonic)	Hex	I/F name	(mnemonic)
00	SYSTEM SERVICE NO OPERATION	(SNOP)			
01	Reserved for BEGIN	(RBGN)			
02	Reserved for END	(REND)			
03	SYSTEM SERVICE RESET	(SRST)			
04	INITIAL SEGMENT	(ISGT)			
05	SUBSEQUENT SEGMENT	(SSGT)			
06	BLOCK	(BLCK)			
07	VIRTUAL MACHINE/GROUP SELECT	(VMGS)			
08	SYSTEM SERVICE ERROR	(SERR)			
09	VIRTUAL GROUP ATTACH	(VGAT)			
0A	VIRTUAL GROUP DISCONNECT	(VGDT)			
0B					
0C					
0D					
0E					
0F					
10	ASSIGN LINKAGE	(ALNK)	10	LINKAGE	(LINK)
11	DEASSIGN LINKAGE	(DLNK)	11	STATUS	(STAT)
12	ASSIGN SUPERVISORY LEVEL GROUP	(ASGP)	12	SUPERVISORY LEVEL GROUP	(SGRP)
13	DEASSIGN SUPERVISORY LEVEL GROUP	(DSGP)	13	VIRTUAL GROUP	(VGRP)
14	ASSIGN VIRTUAL GROUP	(AVGP)	14		
15	DEASSIGN VIRTUAL GROUP	(DVGP)	15		
16	BC READ	(BCRD)	16		
17	BC I/F ITEM RESPONSE	(BIRE)	17		
18	REQUEST TIME TRANSMISSION	(RQTT)	18		
19	BUS CONTROLLER USER DEFINED	(BCUD)	19		
1A			1A		
1B			1B		
1C			1C		
1D			1D		
1E			1E		
1F	EXTENSION	(SEXT)	FF	EXTENSION	(SIEX)

NOTES –
1 Information field names 03_h – $0F_h$ are reserved.
2 The following convention is used in all messages (system service, common, and type-specific):
– most-significant byte (MSB) is transmitted first;
– least-significant bit (lsb) is transmitted last.

4 Keywords

00 SYSTEM SERVICE NO OPERATION — trib- and bc- System service no operation. Relayed by bc.

Format: <SYSTEM SERVICE NO OPERATION>

01 Reserved for BEGIN
02 Reserved for END — These codes are reserved for BEGIN and END delimiters. They are used in the form:
<BEGIN>
<command or I/F list>
<END>
Relayed by bc.

03 SYSTEM SERVICE RESET — trib- System service reset. Resets all system service level functions to the power-up default state:
Virtual machine select – 0
Virtual groups disconnected
Segmentation off.
bc- Select virtual circuit 0 for the addressed tributary. Sent by bc.

Format: <SYSTEM SERVICE RESET>

04 INITIAL SEGMENT — trib- Directs the system service level to commence segment assembly.
bc- Do not parse message further.
Relayed by bc.

Format: <INITIAL SEGMENT>
<SEGMENT COUNT> — 8-bit binary unsigned number; count zero is the final segment.
<SEGMENT DATA ...>

NOTE – The final byte of a data segment shall be the final byte of a supervisory level message block.

05 SUBSEQUENT SEGMENT — trib- Directs the system service level to continue segment assembly.
bc- Do not parse message further.
Relayed by bc.

Format: <SUBSEQUENT SEGMENT>
<SEGMENT COUNT> — 8-bit binary unsigned number; count zero is the final segment.
<SEGMENT DATA> ...

NOTES –
1 The final byte of a data segment shall be the final byte of a supervisory level message block.
2 A tributary with multiple virtual machines attached must provide separate segmentation facilities for each virtual machine.

06 BLOCK

trib- Directs the system service level to disassemble messages which have been concatenated within a single supervisory level message block. The BLOCK command shall be employed to delimit messages on every occasion where message concatenation is employed.
bc- Looks at end of block for system service message.
Relayed by bc.

Format: <BLOCK>
<BYTE COUNT> — 8-bit binary unsigned number. Specifies the length of the individual blocked message, in bytes, not including the byte count.
<BLOCK DATA> ...

07 VIRTUAL MACHINE/GROUP SELECT

trib- Directs the system service level to select the specified virtual machine or group.
bc- Selects the virtual circuit linkage for the indicated virtual machine.

Format: <VIRTUAL MACHINE/GROUP SELECT>
<VIRTUAL MACHINE/GROUP NUMBER> — 8-bit binary unsigned number in the range $00_h - EF_h$ (machine), $F0_h - FF_h$ (group). 00_h is default.

08 SYSTEM SERVICE ERROR

trib- and bc- Advises that the system service command in the last frame received had not been understood, or could not be performed. Following detection of a SYSTEM SERVICE ERROR condition, no further processing will take place on the supervisory level frame, although any virtual machine message(s) encountered up to that point will still be forwarded to their destinations.
Relayed by bc.

Format: <SYSTEM SERVICE ERROR>
<EXEC CODE> — 8-bits
00 - parse error
01 - cannot do by design
02 - insufficiently equipped
03 - buffer overflow
04 - invalid keyword argument
05 - destination tributary unavailable
<BYTE COUNT> — 8-bits; not including the byte count
<OFFENDING COMMAND>

09 VIRTUAL GROUP ATTACH

trib- Directs the system service level to attach the specified virtual machine to the specified virtual machine group.
bc- Never received.
Sent by bc.

Format: <VIRTUAL GROUP ATTACH>
<VIRTUAL MACHINE NUMBER> — 8-bit binary unsigned number in the range 00_h to EF_h. 00_h is default.
<VIRTUAL GROUP NUMBER> — 8-bit binary unsigned number in the range $F0_h$ to FF_h only.

0A VIRTUAL GROUP DISCONNECT

trib- Disconnects the specified virtual machine from the specified virtual machine group.
bc- Never received.
Sent by bc.

Format: as VIRTUAL GROUP ATTACH — 00_h removes all group assignments for a particular virtual machine.

10 ASSIGN LINKAGE

trib- Never received.
bc- Directs the bus controller system service level to establish a unidirectional linkage.

Format: <ASSIGN LINKAGE>
<SOURCE>
<DESTINATION>

Where SOURCE = Supervisory level select address + virtual machine number (default is 00_h);
and DESTINATION = Supervisory level select address + virtual machine number or virtual group number (default is 00_h)
or DESTINATION = Supervisory level group select address + virtual group number (default is 00_h).

11 DEASSIGN LINKAGE

trib- Never received.
bc- Directs the system service level to terminate the specified unidirectional linkage.

Format: as ASSIGN LINKAGE

12 ASSIGN SUPERVISORY LEVEL GROUP
trib- Never received.
bc- Directs the bus controller to assign a tributary to the designated group.

Format: <ASSIGN SUPERVISORY LEVEL GROUP>
<TRIBUTARY SELECT ADDRESS>
<SUPERVISORY GROUP SELECT ADDRESS>

13 DEASSIGN SUPERVISORY LEVEL GROUP
trib- Never received.
bc- Directs the bus controller to remove a tributary from a designated group.

Format: as ASSIGN SUPERVISORY GROUP

14 ASSIGN VIRTUAL GROUP
trib- Never received.
bc- Directs the bus controller to assign a virtual machine to a virtual group.

Format: <ASSIGN VIRTUAL GROUP>
<MACHINE>
<VIRTUAL GROUP NUMBER>

Where MACHINE = Tributary select address + virtual machine number.

15 DEASSIGN VIRTUAL GROUP
trib- Never received.
bc- Directs the bus controller to remove a virtual machine from a virtual group.

Format: as ASSIGN VIRTUAL GROUP

16 BC READ
trib- Never received.
bc- Directs the bus controller to transmit the instantaneous contents of the information field.

Format: <BC READ>
<I/F NAME>

Note– The I/F NAME may be replaced by several names wrapped in a BEGIN/END construct.

17 BC I/F ITEM RESPONSE
trib- Contains the I/F data in response to a BC READ command.
bc- Never received.

Format: <BC I/F ITEM RESPONSE>
<I/F NAME>
<I/F VALUE>

Note– Several I/F NAMES/VALUES may be wrapped in a BEGIN/END construct.

18 REQUEST TIME TRANSMISSION
trib- Never received.
bc- Directs the bus controller to transmit the value of the master system clock to all virtual machines using the common message TIMELINE RUN.

Format: <REQUEST TIME TRANSMISSION>

19 BUS CONTROLLER USER DEFINED
trib- Never received.
bc- Directs the bus controller to enter the user defined command state. On entry to such a state the specific bus controller parses the data bytes which follow. This will be manufacturer-, operator-, and/or installation-dependent.

Format: <BUS CONTROLLER USER DEFINED>
<BYTE COUNT> 8-bit binary unsigned number. Specifies the length of the command in bytes, not including the byte count itself.
<RAW DATA>

1F EXTENSION
trib- and bc- Directs the tributary or bus controller to enter the extension command set for the following single command only. They shall then resume execution of the basic command set.

Format: <EXTENSION>
<EXTENSION SET COMMAND> (one or more bytes)

5 Information fields

10 LINKAGE
Contains all the linkage information.

Format: <LINKAGE>
<BEGIN>
<SOURCE>
<DESTINATION>
...
<SOURCE>
<DESTINATION>
<END>

Where SOURCE = Supervisory level select address + virtual machine number (default is 00_h);
and DESTINATION = Supervisory level select address + virtual machine number or virtual group number (default is 00_h)
or DESTINATION = Supervisory level group select address + virtual group number (default is 00_h).
When necessary, the linkage information may be segmented.

11	STATUS	Tallies the system service level status.

Format: <STATUS>

<STATUS REPORT>	00_h: Linkage directory established; clock available 01_h: No linkage directory; clock available 10_h: Linkage directory established; no clock available 11_h: No linkage directory; no clock available

12	SUPERVISORY LEVEL GROUP	Contains all active supervisory level (S/L) groups excluding All Call, with the associated tributary addresses.

Format: <SUPERVISORY LEVEL GROUP>

<S/L GROUP IDENTIFIER>	16-bit binary unsigned number.
<BEGIN>	
<S/L SELECT ADDRESS>	Multiple groups may be nested with BEGIN/END.
...	
<S/L SELECT ADDRESS>	When necessary, the message may be segmented.
<END>	

13	VIRTUAL GROUP	Contains all active virtual groups with the associated virtual machine identifiers.

Format: <VIRTUAL GROUP<

<VIRTUAL GROUP NUMBER>	8-bit binary unsigned number in the range $F0_h$ to EF_h
<BEGIN>	
<Supervisory level select address>	
<VIRTUAL MACHINE NUMBER>	8-bit binary unsigned number in the range 00_h to FF_h
...	
<Supervisory level select address>	Multiple groups may be nested with
<VIRTUAL MACHINE NUMBER>	BEGIN/END.
<END>	When necessary, the message may be segmented.

FF	EXTENSION	Indicates that the next information field name is a member of the extension set.

Format: <EXTENSION>
<EXTENSION SET I/F NAME>

Annex A (informative)
General concepts

The following text contains a general explanation of some of the concepts used in the formulation of the system service message set. It constitutes tutorial information, and is intended to assist in the understanding of the specifications in previous portions of this practice.

A.1 System service tasks

System service messages can affect all participants on the bus, tributaries as well as the bus controller; their effect, however, differs between tributaries and the bus controller.

Some system service messages address the bus controller only. These originate in a tributary and cause the bus controller to set up a new internal condition, or to originate further messages. Examples:

ASSIGN LINKAGE
DEASSIGN LINKAGE
ASSIGN SUPERVISORY LEVEL GROUP
DEASSIGN SUPERVISORY LEVEL GROUP
ASSIGN VIRTUAL GROUP
DEASSIGN VIRTUAL GROUP

Other system service messages are sent by the bus controller to accomplish linkage tasks in tributaries. Examples:

VIRTUAL GROUP ATTACH
VIRTUAL GROUP DISCONNECT
VIRTUAL MACHINE/GROUP SELECT

Finally there are system service messages which accompany virtual machine messages from source to destination and have no practical effect on the bus controller. These are simply relayed by the bus controller. Examples:

BLOCK
INITIAL SEGMENT
SUBSEQUENT SEGMENT

Notes in the system service message list indicate the effect of the messages on the tributary and the bus controller respectively, and give detailed information about their effect.

A.2 Blocking and segmenting

Information about blocking and segmenting of virtual machine messages by the use of the corresponding system service messages is given in SMPTE RP 139-1992.

A.3 Addressing virtual machines

Since more than one virtual machine logically may be connected to a tributary, the address of every virtual machine is in two parts:

- the tributary address;
- the virtual machine number which identifies the virtual machine connected to this tributary.

Messages which specify a virtual machine must carry both tributary address and virtual machine number as joint parameters. When a single virtual machine only is attached to a tributary address, the virtual machine number defaults to zero (00_h).

A.4 Assigning linkages

In order to establish a linkage it is necessary to make an entry in the linkage directory of the bus controller. Unless the bus controller is very simple (setting up linkages by thumbwheels or a local keyboard only), system service messages originating in any tributary may be used to establish a linkage entry.

The relevant messages are:

ASSIGN LINKAGE and DEASSIGN LINKAGE

Either message carries parameters which specify the tributary address and virtual machine number of both source and destination; each such message assigns/deassigns a unidirectional linkage only, from one source to one destination.

In the assignment of groups the tributary address may be replaced by a supervisory level group address, and/or the virtual machine number may be replaced by a virtual group number.

Application details and examples of tributary linkage are given in SMPTE RP 139-1992.

The linkage of groups is described below.

A.5 Assigning groups

The operational requirement for the grouping of virtual machines may come from any individual tributary, or from an assignment virtual machine. However, only the bus controller is able to establish groups, and system service messages are required, therefore, to instruct the bus controller to take the necessary actions.

A.6 Supervisory level groups

In order to set up a controlled supervisory level group, two actions need to be taken by the assigning virtual machine:

- direct the bus controller to assign a linkage between the controlling virtual machine and the newly defined supervisory group;
- direct the bus controller to assign all tributaries that are to be members of the new group.

Linkage assignment is initiated by an ASSIGN LINKAGE message to the bus controller as described above, but using the desired supervisory level group address and virtual group number instead of a tributary address and virtual machine number.

Where a single virtual machine only is attached to each and every tributary within a supervisory level group, the virtual group number defaults to zero (00_h).

Assignment of the required tributaries to the group is initiated by multiple system service messages, using the command

ASSIGN SUPERVISORY LEVEL GROUP

to the bus controller. In reaction to each of these messages the bus controller generates a supervisory level GROUP ASSIGN message for the appropriate tributary.

The ASSIGN SUPERVISORY LEVEL GROUP message carries two parameters:

- the tributary select address, which identifies the appropriate tributary;
- the desired supervisory level group select address.

Deassignment is performed similarly using the messages:

DEASSIGN LINKAGE and
DEASSIGN SUPERVISORY LEVEL GROUP.

A.7 Virtual groups

In order to set up a controlled virtual group, two actions need be taken by the assigning virtual machine:

- direct the bus controller to assign a linkage between the controlling virtual machine and the newly defined virtual group;
- direct the bus controller to assign all virtual machines that are to be members of the new group.

Linkage assignment is initiated by an ASSIGN LINKAGE message to the bus controller as described above, but using the desired virtual group number instead of the virtual machine number following the tributary supervisory level SELECT or GROUP address.

Assignment of the required virtual machines to the group is initiated by multiple system service messages using the command ASSIGN VIRTUAL GROUP to the bus controller.

In reaction to each of these messages the bus controller generates the system service message VIRTUAL GROUP ATTACH and sends it to the system service level of the tributary serving the required virtual machine.

Where a virtual group comprises virtual machines spread across several tributaries, it is the responsibility of the assigning station to direct the bus controller to construct the appropriate supervisory level group using the ASSIGN SUPERVISORY LEVEL GROUP command.

Each ASSIGN VIRTUAL GROUP message carries the parameters:

- the tributary select address and virtual machine number of the virtual machine;
- the desired virtual group number.

Deassignment is performed similarly using the messages DEASSIGN LINKAGE and DEASSIGN VIRTUAL GROUP. The message used by the bus controller to cancel the group assignment of an individual virtual machine is VIRTUAL GROUP DISCONNECT.

A.8 Assignment messages overview

Tables A.1 and A.2 summarize all system service messages which are used for assigning/deassigning linkages and groups, along with their parameters and their effects.

Table A.1 — Messages to the bus controller

Message	Parameters		Action by bus controller
ASSIGN/DEASSIGN LINKAGE	Source	tributary address virtual machine number	Set up internal linkage directory
	Destination	tributary address/group address virtual machine number virtual group number	
ASSIGN/DEASSIGN SUPERVISORY LEVEL GROUP	Tributary address Supervisory level group address		Send supervisory level GROUP ASSIGN/DEASSIGN to appropriate tributary

Table A.2 – Messages from the bus controller

Message	Parameters	Action by tributary
VIRTUAL GROUP ATTACH/ DISCONNECT	Virtual machine number Virtual group number	Commence/cease to react to messages for the specified virtual group number

A.9 Selecting virtual machines/groups

To switch the data flow path to a specified virtual machine/group within the system service level of the tributary; or to select the correct virtual circuit linkage for the indicated virtual machine, within the bus controller, VIRTUAL MACHINE/GROUP SELECT is used. Further details are given in SMPTE RP 139-1992.

A.10 Information fields (I/F) within the bus controller

In a manner similar to virtual machines, the bus controller contains information fields.

The bus controller information field comprises:

- a table of all linkages currently established;
- a table of all supervisory level groups;
- a table of all virtual groups;
- status information for the bus controller.

A.11 Clocks

Many applications require a common time scale across several virtual machines. This is usually implemented as a (software) clock, the machine internal clock, which must be synchronized by a simultaneous command to all appropriate virtual machines.

Of all the bus participants only the bus controller can guarantee simultaneous transmission of a preset command for those clocks.

Therefore the bus controller is designated as the keeper of a bus clock that is used to synchronize the timelines in all appropriate tributaries.

To support this general concept, the following assumptions are made:

A.11.1 Bus clock

If present in the system, the bus clock is resident in the bus controller.

The bus clock is set by means external to the control bus.

The bus clock is incremented by an external, unspecified signal (tick) common to all virtual machines.

A.11.2 Machine internal clock

The machine internal clock is resident in the virtual machine level of the tributary.

The machine internal clock is preset by messages carried on the control bus.

The machine internal clock is incremented by the same external, unspecified signal (ticks) as the bus clock.

The machine internal clock may be selected as the source of the machine TIMELINE.

A.11.3 Time synchronization

Machine internal clocks are preset by the bus controller.

The bus controller, using the supervisory level message GROUP SELECT ALL CALL, transmits to all virtual machines connected to the bus, the common message TIMELINE RUN, with the time value from the bus clock.

The bus controller is responsible for transmitting the time consistent with the common external tick signal and intended use of time in the system.

The bus controller performs synchronization of the system in response to the system service message REQUEST TIME TRANSMISSION.

Annex B (informative)
Bibliography

ANSI/SMPTE 207M-1992, Television — Digital Control Interface — Electrical and Mechanical Characteristics

SMPTE RP 113-1992, Supervisory Protocol for Digital Control Interface

SMPTE RP 138-1992, Control Message Architecture

SMPTE RP 139-1992, Tributary Interconnection