SMPTE EG 16:2014
Revision of EG 16-2002

SMPTE ENGINEERING GUIDELINE

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

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Approved
February 11, 2014

Foreword

SMPTE (the Society of Motion Picture and Television Engineers) is an internationally-recognized standards developing organization. Headquartered and incorporated in the United States of America, SMPTE has members in over 80 countries on six continents. SMPTE's Engineering Documents, including Standards, Recommended Practices, and Engineering Guidelines, are prepared by SMPTE's Technology Committees. Participation in these Committees is open to all with a bona fide interest in their work. SMPTE cooperates closely with other standards-developing organizations, including ISO, IEC and ITU.

SMPTE Engineering Documents are drafted in accordance with the rules given in Part XIII of its Operations Manual.

SMPTE EG 16 was prepared by Technology Committee 20F.

Intellectual Property

At the time of publication no notice had been received by SMPTE claiming patent rights essential to the implementation of this Engineering Guideline. However, attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. SMPTE shall not be held responsible for identifying any or all such patent rights.

1 Scope

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. 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 Conformance Notation

Normative text is text that describes elements of the design that are indispensable or contains the conformance language keywords: "shall", "should", or "may". Informative text is text that is potentially helpful to the user, but not indispensable, and can be removed, changed, or added editorially without affecting interoperability. Informative text does not contain any conformance keywords.

All text in this document is, by default, normative, except: the Introduction, any section explicitly labeled as "Informative" or individual paragraphs that start with "Note:"

The keywords "shall" and "shall not" indicate requirements strictly to be followed in order to conform to the document and from which no deviation is permitted.

The keywords, "should" and "should not" indicate that, among several possibilities, one is recommended as particularly suitable, without mentioning or excluding others; or that a certain course of action is preferred but not necessarily required; or that (in the negative form) a certain possibility or course of action is deprecated but not prohibited.

The keywords "may" and "need not" indicate courses of action permissible within the limits of the document.

The keyword “reserved” indicates a provision that is not defined at this time, shall not be used, and may be defined in the future. The keyword “forbidden” indicates “reserved” and in addition indicates that the provision will never be defined in the future.

Unless otherwise specified, the order of precedence of the types of normative information in this document shall be as follows. Normative prose shall be the authoritative definition. Tables shall be next, followed by formal languages, then figures, and then any other language forms.

3 Normative Reference

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.

IEC 61672-1 (2013-09), Electroacoustics — Sound Level Meters — Part 1: Specifications

4 Definitions

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

4.1
sound pressure level, Lp , 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, LpA. The reference sound pressure is 20 µPa.

4.2
reference point
The center of the film aperture in the camera gate, or its equivalent position in a digital camera.

4.3
measurement distance
The distance between the reference point and the measurement point.

4.4
background noise
The A-weighted sound pressure level at the microphone position with the camera inoperative.

5 Acoustical Environment

5.1 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.

5.2 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.)

6 Instrumentation

6.1 General

A sound level meter that meets the requirements of IEC 61672 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.

6.2 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.

7 Camera Installation and Operation

7.1 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 (if normally used).

7.2 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 Section 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.

7.3 Operation of the Camera During Tests

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

– with a film camera, with a film load at least similar to the film stock to be used;

– with a film camera, the film stock used should be fresh, and the perforation pitch control, if present, should be properly adjusted for minimum noise;

– with a film camera, 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 a digital camera, if it records to video tape, with a video tape at least similar to the video tape stock to be used;

– with a digital camera, if it records to memory cards, with a memory card similar to the one to be used;

– with a digital camera, set to “shooting mode” for the cooling fan operation;

– with a digital camera, using the power source (battery or ac power supply) to be used;

– 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.

8 Measurement of Frequency and Time-Weighted Sound Pressure Level

8.1 Meter

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

8.2 Measurements

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

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

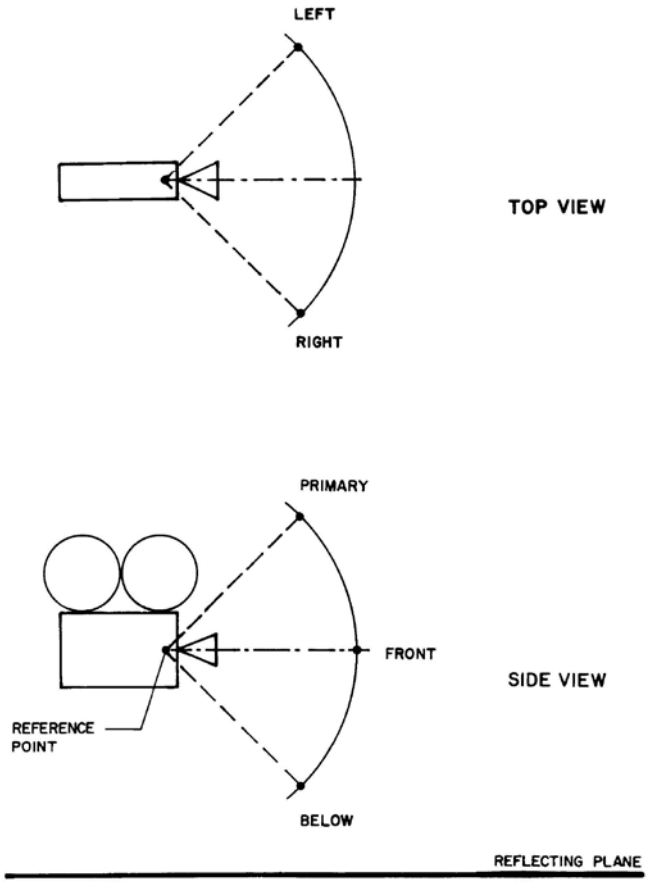

Figure 1 – Measurement locations

8.2.2 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).

8.3 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.

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

9 Limit on Acceptability

Limit on acceptability shall be in accordance with Table 2.

Table 2 – Limit on acceptability

Situation	Maximum permissible sound pressure level, LpA, 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

10 Means for Reducing Camera Noise

10.1 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;

– with a film camera, 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.

10.2 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).

10.3 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 Background (Informative)

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 Tests were carried out in 2010 to ascertain the validity of this measurement method for Digital cameras. The cameras had many different noise floors depending on conditions. The AC supply was noisy, but it is not normally used; batteries are normal. The cameras have cooling fans with rehearsal and take modes. The rehearsal mode measured above the recommendations of SMPTE EG 16, and the feedback from users of the camera is that it is too noisy. The shooting mode had a lower noise floor than the SMPTE EG 16 recommendation, although the solid-state memory modules were quieter than the ones with a video tape scanner running. These have resulted in no complaints and they were below the noise floor established in SMPTE EG 16.

It was concluded that this Engineering Guideline was extensible to digital camera noise with no modification to the method.

A.3 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.4 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.5 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 Bibliography (Informative)

ISO 3741:2010, Acoustics — Determination of Sound Power Levels and Sound Energy Levels of Noise Sources Using Sound Pressure — Precision Methods for Reverberation Test Rooms

ISO 3743-1:2010, Acoustics — Determination of Sound Power Levels and Sound Energy Levels of Noise Sources Using Sound Pressure — Engineering Methods for Small, Movable Sources in Reverberant Fields — Part 1: Comparison Method for a Hard-Walled Test Room

ISO 3743-2:1994, Acoustics — Determination of Sound Power Levels and Sound Energy Levels of Noise Sources Using Sound Pressure — Engineering Methods for Small, Movable Sources in Reverberant Fields — Part 2: Methods for Special Reverberation Test Rooms

ISO 3744:2010, Acoustics — Determination of Sound Power Levels and Sound Energy Levels of Noise Sources Using Sound Pressure — Engineering Method in an Essentially Free Field Over a Reflecting Plane

ISO 3745:2003, Acoustics — Determination of Sound Power Levels of Noise Sources Using Sound Pressure — Precision Methods for Anechoic and Semi-anechoic Rooms

ISO 3746:2010, Acoustics — Determination of Sound Power Levels and Sound Energy Levels of Noise Sources Using Sound Pressure — Survey Method Using an Enveloping Measurement Surface Over a Reflecting Plane