SURFACE VEHICLE RECOMMENDED PRACTICE	J184	AUG2014
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Qualifying A Sound Data Acquisition System

RATIONALE

This document has been determined to contain basic and stable technology which is not dynamic in nature.

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1. ***Scope***—Various SAE vehicle sound level measurement procedures require use of a sound level meter which meets the Type 1 or Type 2 requirements of ANSI S1.4-1983 (see 2.1.1.1), or an alternative system which can be proved to provide equivalent test data. The purpose of this SAE Recommended Practice is to provide a procedure for determining if a sound data acquisition system (SDAS) has electro-acoustical performance equivalent to such a meter. By assuring equivalent performance of the test instrumentation, the equivalence of test data is assured.

Two general configurations of sound data acquisition systems will be encompassed (see Figure 1). The first configuration consists of instrument sections which perform as a sound level meter. The second configuration is a system which records data for later processing. The intent of this document is to establish guidelines which permit the test engineer to insure equivalence of sound data acquisition systems to a sound level meter. It requires that the test engineer have a working knowledge of the characteristics of the sound data being measured.

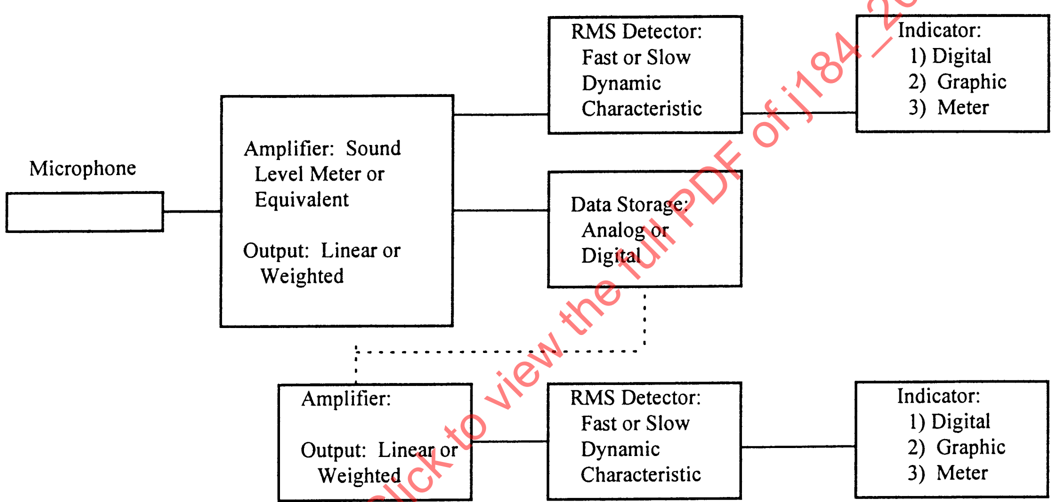

FIGURE 1—SOUND DATA ACQUISITION SYSTEM

The scope of the document includes the system performance requirements for the entire sound measurement system. It provides the methods needed to verify Type 1 or Type 2 instruments. However, it also provides a method to qualify an SDAS that does not meet the requirements in their entirety, but can be used provided knowledge of the test data is obtained and an iterative process is followed in qualifying the SDAS. The system need only be qualified for the dynamic characteristics and weighting mode in which it is to be used. The scope of this document does not include qualification of system components for harmonic distortion, tape recorder wow and flutter, etc. However, these factors must be considered when determining system performance, especially where spectral information is sought. The references in Section 2 should be consulted for general performance requirements and precautions regarding instrumentation for acoustical measurements.

2. References

2.1 Applicable Publications—The following publications form a part of the specification to the extent specified herein.

2.1.1 ANSI PUBLICATIONS—Available from ANSI, 11 West 42nd Street, New York, NY 10036-8002.

2.1.1.1 ANSI S1.4-1983 and S1.4A-1985—Specification for Sound Level Meters

2.1.1.2 ANSI S1.11-1986—Specification for Octave, Half-Octave, and Third-Octave Band Filter Sets

2.1.2 IEC PUBLICATION—Available from International Electrotechnical Commission, 3 rue de Verambe, P.O. Box 131, 1211 Geneva 20, Switzerland.

2.1.2.1 IEC publication 651-1993—Sound Level Meters

2.2 Related Publications—The following publications are provided for information purposes only and are not a required part of this document.

2.2.1 SAE PUBLICATION—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE HS 184—Surface Vehicle Sound Measurement Procedures

2.2.2 ANSI PUBLICATION—Available from ANSI, 11 West 42nd Street, New York, NY 10036-8002.

ANSI S1.1-1986—Acoustical Terminology

2.3 Other Publications

2.3.1 K. Zaveri, "Averaging Time of Level Recorder 2306" and "Fast and Slow Response of Level Recorders 2305/06/07," Bruel & Kjaer, Copenhagen, Denmark, 1975, Technical Review, Issue 2.

2.3.2 P. Hedegaard, "General Accuracy of Sound Level Meter Measurements," Bruel & Kjaer, Copenhagen, Denmark, 1977, Technical Review, Issue 4.

2.3.3 C. G. Wahrmann and J. T. Brock, "On the Averaging Time of RMS Measurements," Bruel & Kjaer, Copenhagen, Denmark, 1975, Technical Review, Issues 2 and 3.

2.3.4 Arnold P.G. Peterson and Ervin E. Gross, Jr., "Handbook of Noise Measurements," 7th Edition, General Radio Company, West Concord, MA, 1972.

2.3.5 R. B. Randall, “Frequency Analysis,” Bruel & Kjaer, Copenhagen, Denmark, 1987.

3. *Definitions*

3.1 Data Signal Range—Twenty times the logarithm (to base 10) of the ratio of highest RMS signal amplitude to lowest RMS signal amplitude for a specific test condition; unit is decibel (dB).

3.2 Dynamic Range—Twenty times the logarithm (to base 10) of the ratio of the instrumentation system maximum signal amplitude to system noise floor amplitude; unit is decibel (dB).

3.3 Frequency Response—Twenty times the logarithm (to base 10) of the ratio of output signal amplitude to input signal amplitude over a specified frequency range as a function of signal frequency; unit is decibel (dB). For a complete sound data acquisition system, it is the indicated sound level minus the sound pressure level at the microphone.

3.4 Full Scale—The maximum undistorted signal level for each instrument.

3.4.1 Full scale for an amplifier is the maximum output signal level. Input full scale can change with amplifier gain.

3.4.2 Full scale for a tape recorder is the maximum signal amplitude defined in 3.6.

3.4.3 Full scale for an indicating instrument is defined as the input voltage for maximum indication.

3.4.4 Full scale for any system component is the maximum output signal level which allows for undistorted signals defined in this recommended practice.

3.5 Indicator—A device used to provide a visual display of signal amplitude.

3.5.1 DIGITAL— A numeric or alpha-numeric display of the measured signal amplitude.

3.5.2 GRAPHIC—A trace recording of the measured signal amplitude on a scaled chart.

3.5.3 METER—Electrically driven needle or other device (possibly digital) which deflects over a calibrated scale as a function of the measured signal amplitude.

3.6 Maximum Signal Amplitude—The signal amplitude below which the harmonic distortion is less than 3% over the operating frequency range.

3.7 Restricted System—Any data acquisition or analysis instrumentation that meets the requirements as specified herein, but only over a limited frequency range.

3.8 Signal Crest Factor—Twenty times the logarithm (to base 10) of the ratio of the peak signal amplitude to the RMS signal amplitude; unit is decibel (dB).

3.9 Signal-to-Noise Ratio—Twenty times the logarithm (to base 10) of the ratio of the data signal amplitude to system noise floor amplitude; unit is decibel (dB).

3.10 System Noise Floor—The broad band electrical noise inherent in instrument circuits with proper input/output terminations.

3.11 Test Apparatus—Equipment used for qualifying, but not part of the Sound Data Acquisition System.

3.12 Digital Signal Processing Terminology—Additional terminology referring to digital systems can be found in Appendix E of ANSI S1.11-1986.

4. System Performance Requirements

4.1 Frequency Response (Amplitude)—The continuous frequency response (linear or A-weighted) of a Type 1 or Type 2 Sound Data Acquisition System shall meet the tolerances in Table 1.

TABLE 1—SYSTEM TOLERANCE LIMITS AND FREQUENCY RESPONSE WEIGHTING FOR A-WEIGHTING

Nominal Frequency Hz	A-Weighting Response (dB)	Tolerance Limits on Response in dB Type 1	Tolerance Limits on Response in dB Type 2
10	–70.4	±4	+5.0, –∞
12.5	–63.4	±3.5	+5.0, –∞
16	–56.7	±3.0	+5.0, –∞
20	–50.5	±2.5	±3.0
25	–44.7	±2.0	±3.0
31.5	–39.4	±1.5	±3.0
40	–34.6	±1.5	±2.0
50	–30.2	±1.0	±2.0
63	–26.2	±1.0	±2.0
80	–22.5	±1.0	±2.0
100	–19.1	±1.0	±1.5
125	–16.1	±1.0	±1.5
160	–13.4	±1.0	±1.5
200	–10.9	±1.0	±1.5
250	–8.6	±1.0	±1.5
315	–6.6	±1.0	±1.5
400	–4.8	±1.0	±1.5
500	–3.2	±1.0	±1.5
630	–1.9	±1.0	±1.5
800	–0.8	±1.0	±1.5
1000	+0	±1.0	±1.5
1250	+0.6	±1.0	±1.5
1600	+1	±1.0	±2
2000	+1.2	±1.0	±2
2500	+1.3	±1.0	±2.5
3150	+1.2	±1.0	±2.5
4000	+1	±1.0	±3
5000	+0.5	±1.5	±3.5
6300	–0.1	+1.5, –2.0	±4.5
8000	–1.1	+1.5, –3.0	±5.0
10 000	–2.5	+2.0, –4.0	+5.0, –∞
12 500	–4.3	+3.0, –6.0	+5.0, –∞
16 000	–6.6	+3.0, –∞	+5.0, –∞
2 0000	–9.3	+3.0, –∞	+5.0, –∞

4.1.1 A Restricted System (linear or weighted) shall meet the tolerances in the continuous frequency range from 1/6 octave above to 1/6 octave below the range specified. For measured data, the total sound level of all bands outside the Restricted range shall be at least 15 dB lower than the overall measured level.

4.1.2 When other weighting networks are used, the frequency response and tolerance of the respective network as specified in ANSI S1.4-1983 shall apply.

4.1.3 Data recorded using a Restricted System shall be designated by type, weighting, dynamic characteristic, and frequency response. For example: Type 1, A, Fast, 100 Hz - 4 kHz.

4.2 Linearity

4.2.1 SYSTEM LINEARITY—For a single range attenuator setting, the linearity error for measurements over the data signal range shall not exceed the tolerances indicated in Table 2, unless limited by a Restricted system.

TABLE 2—SYSTEM LINEARITY REQUIREMENTS

Type 1	within ±0.7 dB	31.5 to 8000 Hz
	within ±1.0 dB	20 to 12 500 Hz
Type 2	within ±1.0 dB	31.5 to 8000 Hz
	within ±1.5 dB	20 to 12 500 Hz

4.2.2 RANGE ATTENUATOR LINEARITY—All settings of the sensitivity range control, either manual or automatic, shall introduce errors less than those specified in Table 2 for a sine wave with respect to a reference signal. If more than one sensitivity range is provided, it is recommended that the ranges be at 10 dB increments.

4.3 Dynamic Characteristic

4.3.1 FAST—The system dynamic response is tested with a 1000 Hz signal instantaneously increased by a minimum of 20 dB to the reference signal level for a duration of 200 ms. The maximum indication shall be within –2.0 to 0 dB with respect to the reference signal for a Type 1 system and within –3.0 to 0 dB for a Type 2 system. Overshoot for a continuous 20 dB increasing step change in level shall be between 0 and +1.1 dB for both Type 1 and Type 2.

4.3.2 SLOW—The system dynamic response is tested with a 1000 Hz signal, instantaneously increased by a minimum of 20 dB to the reference signal level for a duration of 500 ms. The maximum indication will be within –3.1 to –5.1 dB with respect to the reference signal for Type 1 and within –2.1 to –6.1 for Type 2. Overshoot for a continuous 20 dB increasing step change in level shall be 0 to +1.6 dB for both Type 1 and Type 2.

4.3.3 IMPULSE—The system dynamic response is tested with a 1000 Hz signal, instantaneously increased by a minimum of 20 dB to the reference signal level for a duration of 20 ms. The maximum indication will be within –5.1 to –2.1 dB with respect to the reference signal for Type 1 and within –5.6 to –1.6 dB for Type 2.

4.3.4 REFERENCE SIGNAL—The previous requirements apply for a reference signal 4.0 dB below full scale, on a logarithmically scaled indicator. For scales which are linear in dB, such as a graphic level recorder, 63% of maximum indicator deflection corresponds to 4.0 dB below full scale on a logarithmically scaled indicator.

CAUTION—Significant sound level reading variations are possible between systems measuring the same sound even though the system performs within the limits specified in 4.3.1, 4.3.2, and 4.3.3. The dynamic response performance is a function of the indicator ballistics and the detector averaging time which may differ between instruments. Since 4.3.1, 4.3.2, and 4.3.3 do not specify ideal design center circuit performance, a dynamic response model based on a single pole filter is suggested in Section A.1. Ideally, the dynamic response of the indicator should be an order of magnitude faster than the RMS detector dynamic response.

Fast and Slow decay times and additional performance tests for impulse are covered in Sections A.2 and A.3.

4.4 RMS Accuracy—The Sound Data Acquisition System RMS conversion must be within ±0.5 dB of the true RMS value for all signals with crest factors up to and including 10 dB. For test method, see Section A.4.

4.5 Dynamic Range—The Sound Data Acquisition System dynamic range is governed by three factors, the data signal crest factor, the data signal amplitude range, and the system signal-to-noise ratio. The system signal-to-noise ratio must be at least 15 dB to insure that inherent instrument noise does not contribute more than 0.2 dB to the measured level. The system selected for measurement must have a total dynamic range that at least equals the sum of these three factors. Any bandpass filtering or weighting of the data after recording may require a wider dynamic range of the Sound Data Acquisition System. The system noise floor including that of the filter must be 15 dB below the minimum filtered data signal value.

5. Component Requirements

5.1 Microphone—Microphones must meet the directional characteristics described in either ANSI S1.4–1983 or IEC 651-1993 and be used in accordance with the standard chosen. Note that the orientation of the microphone may in some cases affect measurements. This may be the case in the presence of strong components above several kHz.

5.2 Tape Recorders and Other Storage Systems—Generally, wow and flutter requirements will be met if the tape recorder meets the other requirements of this document in the data acquisition environment. In general, wow and flutter are not measurable in digital storage systems.

5.2.1 The brand and type of tape used for data acquisition must be tested with the system recorder to qualify overall recorder performance.

5.3 RMS Detector—Ideally, the RMS detector should control the dynamic response of the Sound Data Acquisition System in the Fast and Slow modes. Practically, the characteristics of the indicating instrument (in particular, analog meters or graphic recorders, where a needle or pen must be physically moved) may influence the dynamic response. When the RMS detector controls the dynamic response, the single pole filter time constants selected shall be 125 ms for Fast and 1 s for Slow (see Section A.1). For Impulse mode, the rise time constant is 35 ms and the decay time constant is 1.5 s. This is more fully described in Section A.3

Note that some systems may provide a selection of averaging time rather than time constant. In those cases the averaging time shall be 250 ms for Fast, 2 s for Slow, 70 ms for the impulse rise time and 3 s for the impulse decay time.

5.4 RMS Indicator Requirements—The indicating instrument shall comply with Section 4, System Performance Requirements. The resolution for the various types of indicators shall be as follows.

5.4.1 GRAPHIC—The scale shall be graduated in no more than 2 dB steps. A resolution of 1 dB steps over a range of, at least, 15 dB is preferred.

5.4.2 DIGITAL—The digital indicator resolution should be at least 0.1 dB. In order to meet the requirements of 4.3.1, 4.3.2, and 4.3.3 for noise of a transient nature, a Hold circuit should be incorporated.

5.4.3 METER—If a meter is used as the readout indicator, the scale shall be graduated in steps not greater than 1 dB over a range of at least 15 dB.

6. Test Procedures—The entire system, without microphone, must be used in the final qualification procedures. All components must be terminated with the correct impedance, including all connecting cables used to collect data. It may be desirable to check the frequency response, linearity, and dynamic range of individual instruments, such as tape recorders, before performing the system test.

6.1 System Frequency Response—The test oscillator amplitude frequency response shall be verified flat (±0.2 dB with a previously calibrated indicator). Corrections for deviation in oscillator output will be used to adjust the system frequency response. The microphone frequency response corrections must be added to obtain the total system frequency response.

6.1.1 LINEAR SYSTEM RESPONSE—The system frequency response must be checked with the previous calibrated oscillator (see Figure 2). The check shall be performed at a level which is 5 dB below full scale (to allow for the tolerance in Table 1) and at least 15 dB above the system noise floor.

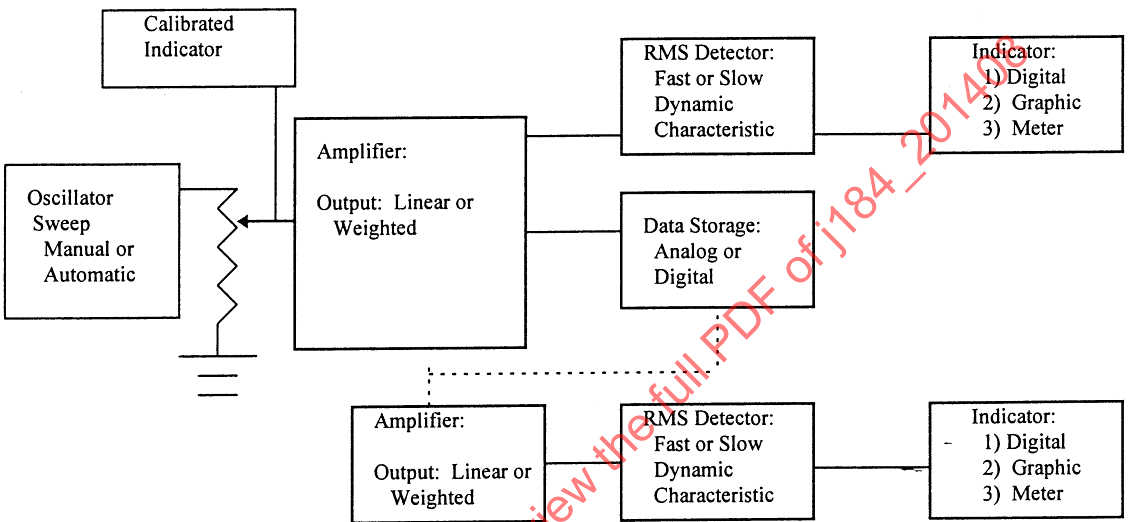

FIGURE 2—FREQUENCY RESPONSE QUALIFICATION

6.1.2 A-WEIGHTED SYSTEMS RESPONSE—When an A-Weighted frequency response is measured, the system internal signal gain, immediately after the A-Weighting network, may be increased by 20 dB for the frequency response verification below 100 Hz and an additional 20 dB for verification below 30 Hz.

6.2 RMS Detector Performance Test—Two methods of testing the RMS detector are outlined in Section A.4. Either of the methods may be used to test the RMS detector.

6.3 System Noise Check—The complete system electronic noise floor should be measured with the microphone removed and replaced with the manufacturers recommended impedance. In some test environments, it may be advisable to also measure the system noise floor with the microphone in place, but acoustically isolated from the sound source and at the actual measurement location during a representative test sequence.

7. General Comments:

7.1 Environmental Responses—Care should be taken to ensure that the instrumentation is operated in an acceptable environment. Refer to the manufacturer's specifications for the effect of temperature, humidity, atmospheric pressure, vibration, and magnetic and electrostatic fields on each component piece of equipment. ANSI S1.4-1983 lists the required tolerance for which manufacturer data are not available.

7.2 Dynamic Characteristic and Time Constant—The combined effects of circuit electronics and any indicator ballistic properties on sound data can be termed Dynamic Characteristic. These parameters can vary widely and still meet the requirements of ANSI S1.4-1983 for Fast, Slow, and Impulse. In an effort to minimize variables in sound level meters, the dynamic performance characteristics must be understood. Section A.1 deals with the system dynamic characteristics in terms of a single pole RC filter with a precise time constant.

7.3 Windscreens—The spectrum of sound being measured and, to a lesser extent, the angle of incidence of source to microphone have an effect on the accuracy of Sound Data Acquisition Systems which utilize a windscreen. The windscreen can significantly alter the signal between 1000 Hz and 4000 Hz. Windscreen corrections on data may be provided by the manufacturer or by on-off comparison measurements under very carefully controlled conditions. Wind induced noise is often insignificant on weighted data, particularly with the wind speed limitations imposed in SAE sound level measurement procedures. It should be noted that contaminants such as dirt and oil may affect the response of the windscreen. Their characteristics may also change with use.

7.4 Frequency Weighting—A-weighting the signal before recording for later processing can reduce the need for unnecessary wide dynamic range because dominating low frequency data will be attenuated.

7.5 Digital Systems—Digital systems require additional components that must be properly designed/selected to meet the requirements of Section 6. Some of the design considerations include sampling frequency, aliasing, and quantization error. The additional components include antialiasing filters, sample and hold circuits, and analog to digital converters. A complete set of design guidelines to cover all of these topics falls outside of the scope of this document. A discussion of all of these topics can be found in Appendix E of ANSI S1.11-1986 (see 2.1.1.2).

8. Notes

8.1 Rationale Statement—Many years have passed since SAE J184 was last revised. In the intervening years the basic rationale for the document itself has not changed, there are many instances where a system is required to provide results equivalent to those obtained with a sound level meter. In fact, this may now be the most common way of making measurements in a wide variety of situations.

Since SAE J184 was last revised, however, equipment has changed a great deal. With each passing year there are fewer people using chart recorders or electro-mechanical meters. There is still a desire, however, to duplicate measurements made with Type 1 and Type 2 sound level meters. In fact, over 30 SAE standards specify that either a sound level meter be used (meeting the requirements of ANSI S1.4-1983) or an equivalent system meeting the requirements of SAE J184.

This revision of SAE J184 is intended to bring it up to date with the current specifications outlined in ANSI S1.4-1983 and IEC 651-1993. In addition, sections have been added to incorporate digital technology. It was originally intended to add quite a few sections regarding the design of digital systems that would meet the requirements of SAE J184. After much discussion, however, it was decided that a proper treatment would be quite lengthy and was beyond the scope of SAE J184. In addition, SAE J184 specifies the performance of the system. These performance requirements must be met regardless of whether the analysis system is analog or digital. In fact, though the measurement systems have evolved considerable over the years, the desire to provide a sound data acquisition system that has the characteristics of a Type 1 or Type 2 sound level meter has not changed.

8.2 Relationship to ANSI and IEC Standards—This document follows both the ANSI and the IEC sound level meter standards. In general, there are very small differences between the IEC and the ANSI documents. The largest difference is the requirement of a random incidence microphone in the ANSI standard and a free field microphone in the IEC document. The approach of SAE J184 is that either of these is acceptable as long as the guidelines in the appropriate standard are followed.

SAE J184 permits a restricted frequency range in those cases in which it is known that no significant energy exists outside of the measurement band. This is not allowed in either the ANSI or IEC standards

In the few cases where there are differences between the ANSI and IEC standards, the ANSI sound level meter standard, S1.4-1983, has been followed.

8.3 Marginal Indicia—The change bar (l) located in the left margin is for the convenience of the user in locating areas where technical revisions have been made to the previous issue of the report. An (R) symbol to the left of the document title indicates a complete revision of the report.

8.4 Keywords:—Acoustics, instrumentation, noise, calibration, sound level meter, SLM, sound data acquisition system, SDAS, microphone, detector, RMS, frequency response, windscreen, digital, dynamic range, impulse.

PREPARED BY THE SAE MOTOR VEHICLE COUNCIL SOUND LEVEL COMMITTEE

APPENDIX A

***Preface*—**The following sections are intended to provide information for further verification of the system dynamic characteristic. These supplement the requirements of ANSI S1.4-1983 and are intended for better characterization of the SDAS.

***A.1 System Dynamic Characteristic*—**The single point specification for dynamic characteristics of 4.3.1 and 4.3.2 is broad enough to allow significant variations between systems in measurement of transient data. To alleviate this potential problem, this document is suggesting that a simple first order system be adopted as the model for system response. The following suggested model does not intend to supersede the previous requirements, but to provide a model such that evaluation of all transient data will be made on a uniform basis. The single tone burst response specification of 4.3.1 and 4.3.2 meets the design center values of the model at the tone burst lengths specified.

Figure A1 is a block diagram of an RMS detector and indicator. The dynamic response to step changes in level is defined by Equations A1 and A2:

$$e_0 = e_{in}(1 - e^{-T/RC})^{1/2} \quad \text{for increasing signal levels} \tag{Eq. A1}$$

$$e_0 = e_{in}(e^{-T/RC})^{1/2} \quad \text{for decreasing signal levels} \tag{Eq. A2}$$

e_0 and e_{in} in volts

T—Time from beginning of step change

RC—Electrical time constant of the circuit

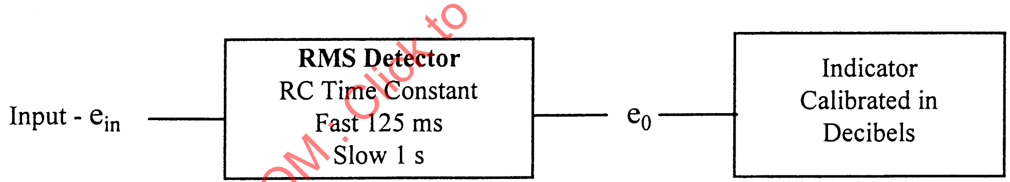

FIGURE A1—RMS DETECTOR INDICATOR

The RC time constant shall be 0.125 s for Fast and 1 s for Slow (as shown in Table A1) and these time constants shall determine the system dynamic response. This requires the indicator response to be approximately ten times faster than the time constant.

TABLE A1—DYNAMIC PERFORMANCE TO INCREASING STEP INPUT CHANGES

Time Constant	Duration of Step Change, ms	Response Referred to Continuous Level e_0	Response Referred to Continuous Level dB
Fast	Continuous	1.00	0.00
125 ms	200	0.89	–1.00
	100	0.74	–2.60
	50	0.57	–4.80
	20	0.38	–8.30
	5	0.20	–14.10
Slow	Continuous	1.00	0.00
1 s	2000	0.93	–0.60
	1000	0.80	–2.00
	500	0.63	–4.10
	200	0.43	–7.40
	50	0.22	–13.10

A.2 Dynamic Characteristic Decay Performance—The indicator decay for Fast from an indication 4.0 dB below full scale shall be at least 10 dB in 0.5 s when the signal is removed. Under the same test conditions, the indicator decay for Slow will be at least 10 dB in 3.0 s.

A.3 Impulse Mode—Figure A2 is a block diagram of an impulse detector indicator.

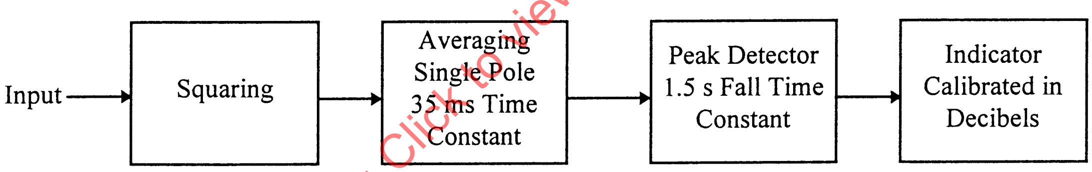

FIGURE A2—IMPULSE DETECTOR/INDICATOR

A.3.1 Frequency Response—When a continuous test signal is applied, the indication in impulse mode shall be the same as the indication in Fast and Slow within 0.1 dB between 31.5 Hz and 8 kHz.

A.3.2 Single Burst Response

A.3.2.1 The tone burst indications in Table A2 shall be met for a single sinusoidal burst with frequency of 2 kHz and a duration T.

TABLE A2—SINGLE BURST RESPONSE

T in ms	Indication dB below Full Scale	Tolerance dB Type 1	Tolerance dB Type 2
Continuous	0	Ref	Ref
20	–3.6	±1.5	±2.0
5	–8.8	±2.0	±3.0
2	–12.6	±2.0	No test

A.3.2.2 When the burst duration is held constant at 2 ms and the input amplitude is increased by 10 dB, the indication must increase by 10 dB ± 1 dB for a Type 1 system. For a Type 2 system, the test shall be performed with a burst duration of 5 ms and an amplitude step of 5 dB. The indication shall increase by 5 dB ± 1 dB.

A.3.3 Multiple Burst Response

A.3.3.1 The following indications of Table A3 shall be met for continuous sequence of sinusoidal bursts having a frequency of 2 kHz, a duration of 5 ms, and a repetition frequency F.

TABLE A3—MULTIPLE BURST RESPONSE

F in Hz	Indication dB below Full Scale	Tolerance dB Type 1	Tolerance dB Type 2
Continuous	0	Ref	Ref
100	–2.7	±1.0	±2.0
20	–7.6	±2.0	±2.0
2	–8.8	±2.0	±3.0

A.3.3.2 When the repetition rate is held at 2 Hz, and the input amplitude is increased by 5.0 dB, the indication must increase by 5.0 dB ± 1 dB.

A.3.4 Impulse Decay Performance

A.3.4.1 When the continuous signal is suddenly decreased to zero, the indication must decrease by 2.9 dB per second ± 0.5 dB per second for Type 1 instruments and 2.9 dB per second ± 1.0 dB per second for Type 2 instruments.

A.4 RMS Detector Tests

A.4.1 RMS Detector Test Method 1—Connect the equipment as shown in Figure A3. The R value shall be 1% or less than the Detector Indicator System (DIS) input impedance. The DIS input may be applied through a suitable network replacing the microphone, or in series with the microphone if acoustic pickup can be made negligible. Perform the tests indicated in Table A4.

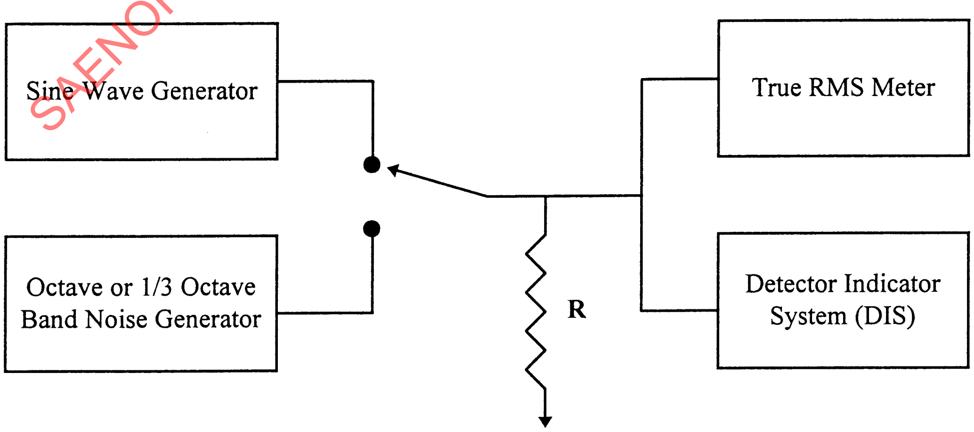

FIGURE A3—RMS DETECTOR TEST METHOD 1

TABLE A4—RMS DETECTOR TEST REQUIREMENTS

	Frequency Hz	Input	Indicated Value dB below Full Scale	Function	Averaging Time
Test 1	1000 Hz	Sine Wave	–1.0	Set	Fast
	1000 Hz Band	Noise	–1.0 ± 0.5	Read	Fast
Test 2	1000 Hz	Sine Wave	–10.0	Set	Fast
	1000 Hz Band	Noise	–10.0 ± 0.5	Read	Fast
Test 3	6300 Hz	Sine Wave	–1.0	Set	Fast
	6300 Hz Band	Noise	–1.0 ± 0.5	Read	Fast
Test 4	6300 Hz	Sine Wave	–10.0	Set	Fast
	6300 Hz Band	Noise	–10.0 ± 0.5	Read	Fast
Test 5	63 Hz	Sine Wave	–1.0	Set	Slow
	63 Hz Band	Noise	–1.0 ± 0.5	Read	Slow
Test 6	63 Hz	Sine Wave	–10.0	Set	Slow
	63 Hz Band	Noise	–10.0 ± 0.5	Read	Slow

For each test, adjust the sine wave generator level and the DIS gain controls for the required indicated value. Adjust the noise generator average RMS value to equal the sine wave generator RMS value as indicated on the True RMS meter. The DIS average reading must be within ±0.5 dB of the sine wave reading.

Use C or Flat weighting in Tests 3 to 6. If neither C nor Flat is provided, signals should be connected to the linear electronics section of the DIS between the weighting networks and the detection system.

If A or B weighting must be used for the tests, the 63 Hz tests should be modified. Set the sine wave frequency as shown in Table A5.

TABLE A5—FREQUENCY CORRECTION FOR 63 Hz TEST

Weighting	Octave	1/3 Octave
A	67.4 Hz	63.6 Hz
B	64.9 Hz	63.4 Hz

For Tests 5 and 6, the average meter deflection may be determined by averaging 50 instantaneous deflection readings taken at least 2 s apart.

Alternatively, if provided, use a longer averaging time. The meter fluctuations must be less than ±0.25 dB using this method.

The 1/3 octave or octave bands of noise should be derived from a gaussian noise source that is pink over the range from at least 20 Hz to 20000 Hz, within ±1 dB. The filters must meet the Class II or III requirements of ANSI S1.11-1986. Pink means a spectrum level downward slope of 3 dB/Octave applied to gaussian random noise. Above 20 kHz, the slope must fall at this rate or faster.

A.4.2 RMS Detector Test Method 2—The RMS accuracy is tested by comparing the indication for a reference sine wave to a continuous sequence of rectangular pulses and a sequence of tone bursts. The reference sine wave frequency shall be 2 kHz. The rectangle test pulses shall have durations of 200 µs and rise times of less than 10 µs. The tone burst test signal shall consist of an integer number of sine waves (2 kHz) starting and ending at zero crossing. The repetition frequency shall be 40 Hz.

The reference sine wave and test signals shall have identical RMS values. The signals are compared using a weighting network prior to the reference meter identical to the sound level meter weighting within the tolerances of Table 1. The C-weighting characteristic or Flat shall be used. If the instrument has only A– or B–weighting, test with tone bursts only.

The test signal is connected to the electrical input of the sound level meter. The test is performed in Slow dynamic characteristic, or in Fast if Slow is not available.

Both positive and negative going pulses are used in the rectangular pulse test. The test shall be performed at 1 dB below the upper limit of the specified measuring range and at intervals of 10 dB below this level down to the lowest level that produces an indication of more than 3 dB on the indicator.

A.4.2.1 RECTANGULAR PULSE TEST— Apply the 2000 Hz sine wave reference signal by switching to Reference as shown in Figure A4. Adjust the sine wave reference signal level until the SDAS indicator is 1 dB below the upper limit of the specified measuring range. Note the indication of the reference RMS meter.

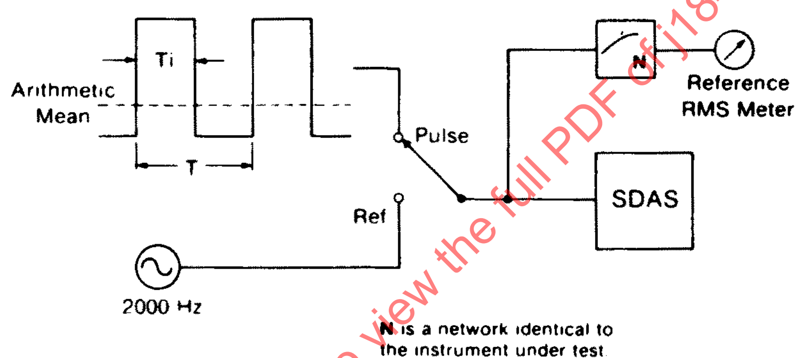

FIGURE A4—RECTANGULAR PULSE TEST

Apply the appropriate rectangular pulse sequence as shown in Table A6 by switching to Pulse. Adjust the pulse generator amplitude for the same indication on the reference RMS meter. The SDAS indication must be within the limits shown in Table A5.

TABLE A6—RECTANGULAR PULSE TEST VALUES

SLM Type	Crest Factor 10 dB Ti ms	Crest Factor 10 dB T ms	Crest Factor 10 dB Accuracy dB	Crest Factor 14 dB Ti ms	Crest Factor 14 dB T ms	Crest Factor 14 dB Accuracy dB	Crest Factor 20 dB Ti ms	Crest Factor 20 dB T ms	Crest Factor20 dB Accuracy dB
Type 1 Impulse	0.2	2.0	±0.5	0.2	5.2	±1.0	0.2	20.2	±1.5
Type 1	0.2	2.0	±0.5	—	—	—	—	—	—
Type 2 Impulse	0.2	2.0	±1.0	0.2	5.2	±1.0	—	—	—
Type 2	0.2	2.0	±1.0	—		—	—	—	—