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INTERNATIONAL
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SURFACE VEHICLE RECOMMENDED PRACTICE

SAE J247

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Submitted for recognition as an American National Standard

INSTRUMENTATION FOR MEASURING ACOUSTIC IMPULSES WITHIN VEHICLES

***Foreword*—**This Reaffirmed Document has been changed only to reflect the new SAE Technical Standards Board Format.

***1. Scope*—**The purpose of this SAE Recommended Practice is to provide guidelines for selection and application of instrumentation for proper measurement of acoustic impulses within vehicles, as typified by those generated during the deployment of a passive restraint system. The objective is to achieve uniformity in instrumentation practice and reporting of test measurements. Use of this recommended practice should provide a basis for meaningful comparisons of test results from different sources.

2. References

2.1 Applicable Publications—The following publications form a part of the specification to the extent specified herein. Unless otherwise indicated the lastest revision of SAE publications shall apply.

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

SAE J941 MAR81—Passenger Car Driver's Eye Range

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

ANSI S1.1 - 1960 (R1976)—Acoustic Terminology
ANSI S1.13 - 1971 (R1976)—Methods for the Measurement of Sound Pressure Levels

3. Definitions

3.1 Transducer—Microphone, pressure transducer, or other device along with integral conditioning used for pressure transduction.

3.2 Full-Scale—Maximum usable range of an instrument or system.

3.3 Data Channel—All of the instrumentation from and including a single transducer up to and including any display or analysis device or procedure that may alter the frequency content of the data. (Long cables, in particular, are not to be neglected.)

3.4 Data Channel Full-Scale—The valid range of a data channel, in terms of the input variable, determined by the component in the channel with the lowest full-scale level.

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3.5 Mean Ear Location (MEL)—With reference to Figure 4 of SAE J941 MAR81 the mean ear location (MEL) is defined as a point 10 in. (25.4 cm) inboard from the X–Z plane, 3.5 in. (8.9 cm) rearward of line Z–Z, and 0.5 in. (1.3 cm) below line X–X.

3.6 Initiation Time—That instant in time when the deployment signal is applied to the passive restraint system. (See Figure 1.)

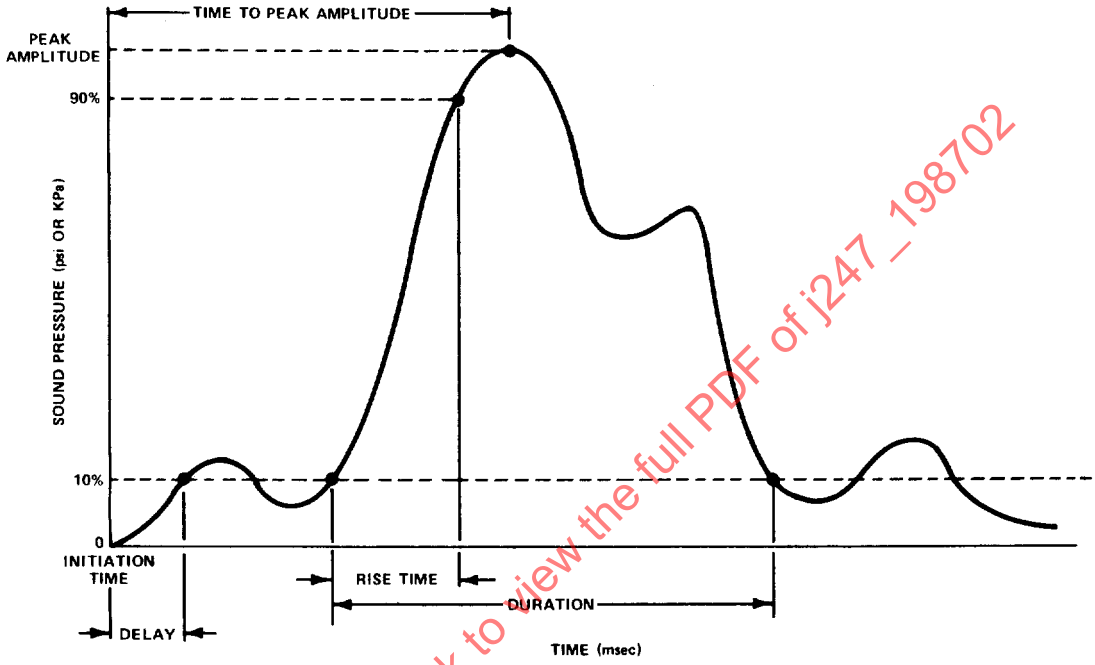

FIGURE 1—WAVEFORM DEFINITIONS

3.7 Peak Amplitude—The maximum value of sound pressure attained, expressed in pounds per square inch (kilopascals). It may also be expressed as sound pressure level in decibles (dB).

3.8 Risetime—The time difference between the occurrence of 90% peak amplitude (in psi or kPa) and the immediately prior occurrence of 10% peak amplitude, expressed in milliseconds.

3.9 Duration—The time difference between occurrences of 10% of peak amplitude (in psi or kPa) immediately before and following the occurrence of peak amplitude, expressed in milliseconds.

3.10 Delay—The time difference between "initiation time" and the initial occurrence of 10% of peak amplitude.

3.11 Sound Pressure Level—Twenty times the logarithm to the base 10 of the ratio of the pressure of a sound to a reference pressure equal to 20 μPa, expressed in decibels. Figure 2 relates peak sound pressure level, in dB, to peak sound pressure, in psi (kPa).

4. Data Channel Specifications—Data channels should conform to the following specifications:

4.1 Maximum Sound Pressure—The data channels should be capable of measuring peak sound pressure levels of 180 dB. However, data channel full-scale may be set lower, depending on anticipated peak amplitudes.

4.2 Frequency Response—The amplitude response, as a function of frequency, is specified in Figure 3.

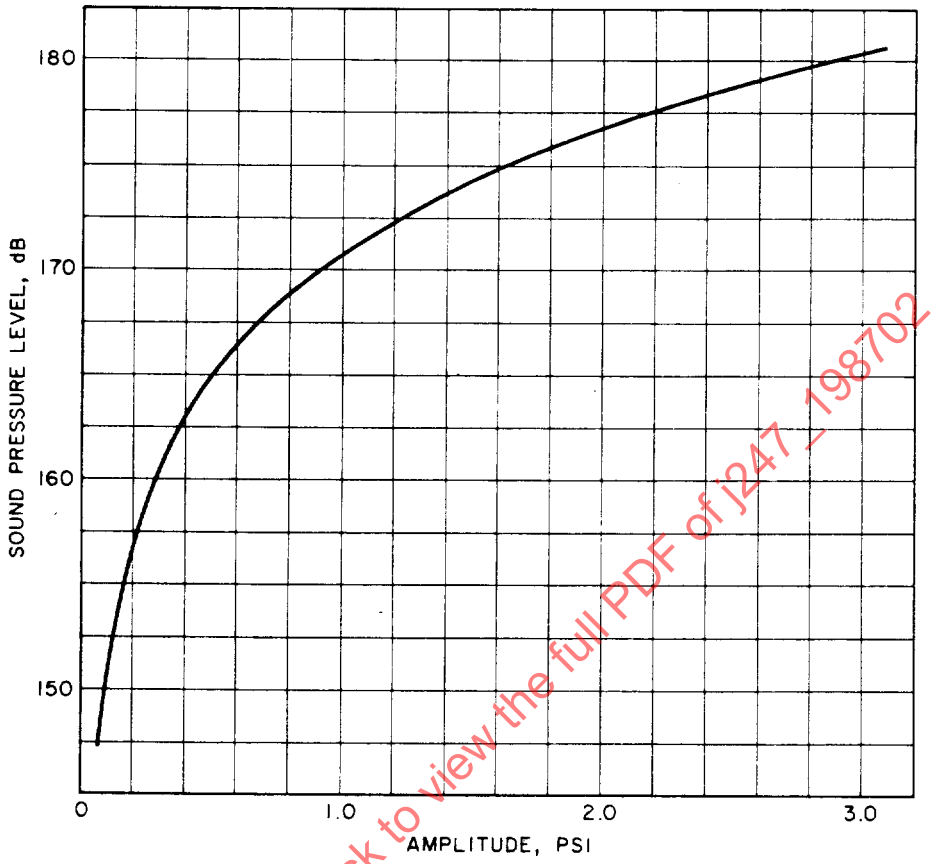

FIGURE 2—PEAK AMPLITUDE VERSUS PEAK SOUND PRESSURE LEVEL

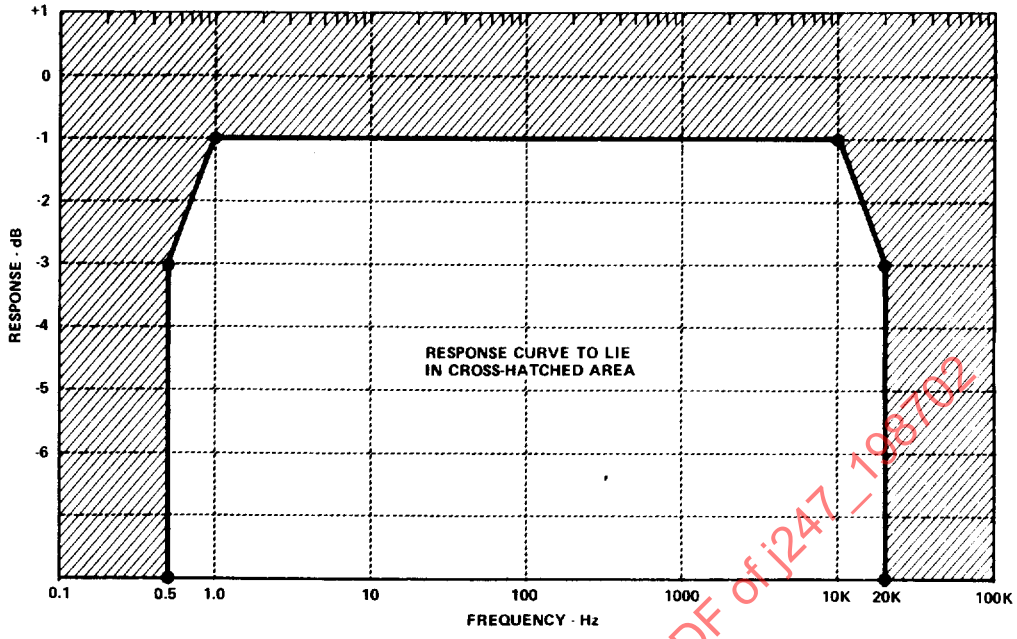

FIGURE 3—DATA CHANNEL FREQUENCY RESPONSE

4.3 Amplitude Linearity—Maximum deviation of the calibration curve from the straight line through its end points should not exceed 1 dB.

4.4 Harmonic Distortion—Not more than 10% at 177 dB peak sound pressure level.

4.5 Overshoot—Not more than 10% for a step pressure input.

4.6 Signal-to-Noise Ratio—At least 40 dB.

5. Calibration Guidelines

5.1 Laboratory Calibrations—Laboratory calibrations should be conducted on a periodic basis, to documented procedures, and with standards and test equipment traceable to the National Bureau of Standards.

5.1.1 Frequency response tests should be conducted at an amplitude equal to full-scale.

5.1.2 Amplitude linearity checks should be made at full-scale and at –20, –40, –60 dB.

5.1.3 Whenever it is impossible to include the transducer in tests under 5.1.1 and 5.1.2, the transducers may be simulated and voltage insertion calibration techniques used. However, the transducers should then be calibrated for amplitude and frequency response according to the manufacturers' recommendations and then installed and the data channel checked with an acoustic calibrator at the highest level possible.

5.1.4 Checks should be made to determine the effects of any anticipated test site conditions (for example, temperature, barometric pressure, mechanical shock, acceleration, photographic lighting, electrical interference, etc.).

5.2 Test-Site Calibrations—Test-site calibrations are end-to-end data channel calibrations.

5.2.1 Closed-coupler acoustic calibration techniques should be used to check the operation and calibration of the transducer.

5.2.2 Calibrations should be conducted at a level equal to or greater than 50% (–6 dB) of data channel full-scale. Voltage insertion techniques using transducer laboratory calibration data may be used.

5.2.3 Several seconds of ambient noise should be recorded to establish the noise floor at the time of the test.

6. ***Test Guidelines—***The following are suggested when conducting acoustic impulse tests:

6.1 Instrumentation used should be properly documented showing latest laboratory calibration dates.

6.2 Test-site calibrations should be conducted before and after each test.

6.3 "Initiation time" (±1 ms) should be recorded along with the acoustic data.

6.4 A time reference (for example, 1 kHz sine or square wave) should be recorded along with the data. This is useful to avoid timing errors when time scaling is employed.

6.5 Data channel full-scale should be selected so that anticipated maximum sound pressures will be within –12 to –2 dB of it.

6.6 Open-window tests should be conducted under free field conditions or out of doors away from walls.

6.7 Care should be exercised to isolate the transducers mechanically, consistent with the test vehicle environment. When the transducer is subjected to accelerations, output compensation may be required.

7. ***Transducer Locations—***At least two locations should be monitored. One is the mean ear location (MEL) for the driver, and the other is a point symmetrical about the vehicle centerline to the MEL for the passenger. It is suggested that additional transducers be located within the vehicle at locations where high sound pressure levels are anticipated (for example, 2 in. (5 cm) out from ears adjacent to closed windows). Whatever locations are selected, they should be described in detail.

8. ***Data Presentation—***The statement of test results should contain at minimum, the following information:

8.1 **Pressure-Time Display—**For each data channel, there should be a graphical display (oscillograph, computer plot, etc.) of sound pressure (psi or kPa) or sound pressure level (dB) as a function of time (ms). A calibration level should also be displayed.

8.2 **Tabulation of Pressure-Time Parameters**

8.2.1 Peak amplitude (express in both psi (kPa) and dB).

8.2.2 Time of occurrence of peak amplitude (ms after "initiation time").

8.2.3 Risetime.

8.2.4 Duration.

8.2.5 Delay.

8.3 **Vehicle Configuration—**A description of the vehicle body size and style, vented area present, restraint system configuration, number and type of dummies, if used, and whether windows were open or closed.