The Engineering Society For Advancing Mobility Land Sea Air and Space®
INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

SURFACE VEHICLE RECOMMENDED PRACTICE

SAE J1105

REAF. SEP89

Issued 1975-05
Reaffirmed 1989-09

Superseding J1105 SEP89

Submitted for recognition as an American National Standard

HORN—FORWARD WARNING—ELECTRIC—PERFORMANCE, TEST, AND APPLICATION

Foreword—This Reaffirmed Document has not changed other than to put it into the new SAE Technical Standards Board Format.

1. Scope—This document establishes the following criteria for electrically operated forward warning horns on mobile construction machinery:

a. Forward warning horn performance requirements
b. Measurement technique for horn performance requirements
c. Laboratory environmental tests
d. Horn activation on the vehicle

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 J184 AUG87—Qualifying a Sound Data Acquisition System

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

ANSI S1.4—1983—Specifications for Sound Level Meters
ANSI S1.11—1966 (R1976)—Specification for Octave, Half-Octave, and Third-Octave Band Filter Sets

2.1.3 MILITARY PUBLICATION—U. S. Government, DOD SSP, Subscription Service Division, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094

Military Standard (MIL-STD-810B)—Environmental Test Methods 510 and 514.1

2.1.4 ASTM PUBLICATION—Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM B 117—Method of Salt Spray (Fog) Testing

QUESTIONS REGARDING THIS DOCUMENT: (724) 772-8512 FAX: (724) 776-0243
TO PLACE A DOCUMENT ORDER; (724) 776-4970 FAX: (724) 776-0790
SAE WEB ADDRESS http://www.sae.org

2.2 Related Publications

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

SAE J994 MAR85—Alarm—Back-Up—Electric—Performance, Test, and Application

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

ANSI S1.1—1960 (R1976)—Acoustical Terminology
ANSI S1.2—1971 (R1976)—Physical Measurement of Sound
ANSI S1.13—1971 (R1986)—Methods for the Measurement of Sound Pressure Levels

2.3 Other Publications

AC Fine and AC Coarse Dust Available from AC Div. General Motors Corp.

3. ***Forward Warning Horn System—***The forward warning horn system (complete system) for purposes of this document consists of a horn and an actuating switch (see Figure 1).

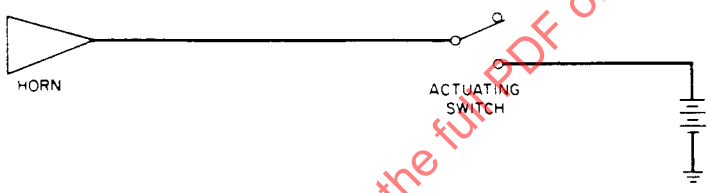

FIGURE 1—FORWARD WARNING HORN SYSTEM SCHEMATIC

4. ***Forward Warning Horn Performance Requirements—***The performance requirements apply at ambient temperature of 77 °F ± 20 (25 °C ± 11) and at normal operating voltage of a 14 or 28 V battery system (nominal 12 and 24 V battery systems) unless otherwise stated and measured as in 5.2 to 5.3.27.

4.1 The predominant sound frequency of the horn shall fall within the frequency range of 710 to 2800 Hz.

4.2 The sound level of the horn shall be measured according to 5.2 and shall be any of the following with tolerances as stated in 4.3, 4.4, and 4.5:

Type J - 117 dB(A)
Type K - 112 dB(A)
Type L - 107 dB(A)
Type M - 97 dB(A)
Type N - 87 dB(A)

4.3 The sound level shall meet the design Type or Types specified and not vary from the values in 4.2 by more than ±4 dB with a normal system voltage of 14 or 28 V.

4.4 The sound level shall not vary more than ±8 dB from the values given in 4.2 for both extremes of the operating voltage range 9.8 to 18.2 V and 19.6 to 36.4 V for 14 and 28 V systems respectively.

4.5 The sound level shall not vary more than ±8 dB from a baseline measurement (determined as specified in 5.3.15) at –40 °F ± 5 (–40 °C ± 3) and 165 °F ± 5 (74 °C ± 3) when the alarm is in the appropriate environmental chamber.

5. Laboratory Measurement Technique

5.1 Instrumentation and Test Facilities

5.1.1 A sound level meter which meets the Type 1 requirements of the ANSI S1.4-1983.

5.1.2 As an alternative to making direct measurements using a sound level meter, a microphone or sound level meter may be used with a magnetic tape recorder and/or a graphic level recorder or indicating meter providing the system meets the requirements of SAE J184.

5.1.3 A filter set which meets the Class II Octave Band requirements of ANSI S1.11-1966 (R1976).

5.1.4 A sound level calibrator

5.1.5 A temperature measuring system

5.1.6 A voltage measuring system

5.1.7 Vibration apparatus

5.1.8 Environmental chamber

5.1.9 Dust chamber

5.1.10 Rain, steam, and corrosion chamber

5.2 Measurements

5.2.1 The horn and a microphone shall be located in a free field 4 ft (1.2 m) above a horizontal reflecting plane or laboratory equivalent, with the microphone 4 ft (1.2 m) from the horn along its 0 deg axis. The 0 deg axis must be parallel to the horizontal reflecting plane. For determination of the sound levels in the appropriate environmental chamber for the extreme temperature tests, 5.2.5. (A free field is defined as an area with no vertical reflecting surface within 17 ft (5 m). A horizontal reflecting plane is defined as the finished concrete in a laboratory or the equivalent when conducting testing in the field.)

5.2.2 The ambient sound level, due to all sources other than the horn, shall be at least 10 dB lower than the A-weighted sound level of the alarm.

5.2.3 The sound level meter shall be set for slow response or equivalent and A-weighting network to check sound level.

5.2.4 The predominant sound level output shall be checked with octave band filters only to determine that the frequency is within acceptable limits. All other sound level checks shall be made using the A-weighting network.

5.2.5 The sound level shall be determined and recorded for the forward warning horn (Type J, K, L, M, or N) when it is actuated in the environmental test chamber at 77 °F ± 20 (25 °C ± 11) and at extreme temperature as specified in 4.5.

5.3 Data Acquisition

5.3.1 All data measurements will be taken during a minimum test period of 5 s operation at ambient temperature of 77 °F ± 20 (25 °C ± 11) and normal battery system voltage of 14 or 28 V unless either temperature or voltage is stated otherwise. The data must be correlated with performance requirements where specified. If

requirements are not met at any step in testing, a decision will be necessary to determine if testing should be continued.

5.3.2 Measure and record the predominant sound frequency of the horn. Correlate data with performance requirements in 4.1.

5.3.3 Measure and record the sound level of the horn. Correlate the data with performance requirements and tolerance from 4.3.

5.3.4 Measure and record the sound level change between extremes of operating voltage range 9.8 to 18.2 V and 19.6 to 36.4 V for 14 or 28 V systems respectively. Correlate the data with performance requirements and tolerance specified in 4.4.

5.3.5 Perform the vibration tests as specified in 6.1 to 6.1.3.

5.3.6 Repeat 5.3.3 and 5.3.4.

5.3.7 Perform rain tests as specified in 6.2.

5.3.8 Repeat 5.3.3 and 5.3.4.

5.3.9 Perform corrosion test as specified in 6.3.

5.3.10 Repeat 5.3.3 and 5.3.4.

5.3.11 Perform steam test as specified in 6.4.

5.3.12 Repeat 5.3.3 and 5.3.4.

5.3.13 Perform dust test as specified in 6.5.

5.3.14 Repeat 5.3.3 and 5.3.4.

5.3.15 Measure and record the sound level of the horn in the environmental chamber to obtain baseline data under conditions specified in 5.3.1.

5.3.16 Measure and record the sound level of the horn in the environmental chamber at –40 °F ± 5 (–40 °C ± 3) after the complete system has been at this temperature for at least 1 h immediately prior to this test. The sound level should be within ±8 dB of the baseline data measured in 5.3.15.

5.3.17 Measure and record the sound level of the horn in the environmental chamber at –40 °F ± 5 (–40 °C ± 3) for both extremes of the operating voltage range 9.8 to 18.2 V and 19.6 to 36.4 V for 14 or 28 V systems, respectively, after the complete system has been at the above temperature for at least 1 h immediately prior to the test. No specified sound level is required, but the horn is to be operational and register a reading on the meter above the existing ambient sound level.

5.3.18 Operate the complete system at –40 °F ± 5 (–40 °C ± 3) in the environmental chamber for 5000 sound pulsation cycles as specified in 6.6.1 and 6.6.2.

5.3.19 Repeat 5.3.16 and 5.3.17.

5.3.20 Repeat 5.3.15 for the environmental chamber that is to be used for the high temperature evaluation.

5.3.21 Measure and record the sound level of the horn in the environmental chamber at 165 °F ± 5 (74 °C ± 3), after the complete system has been at this temperature for 1 h immediately prior to this test. The sound level should be within ±8 dB of that measured in 5.3.20.

5.3.22 Measure and record the sound level of the horn in the environmental chamber at 165 °F ± 5 (74 °C ± 3) at both extremes of the operating range 9.8 to 18.2 V and from 19.6 to 36.4 V for 14 or 28 V systems, respectively, after the complete system has been at the above temperature for 1 h immediately prior to the test. No specified sound level is required, but the horn is to be operational and register a reading on the meter above the existing ambient sound level.

5.3.23 Operate the complete system at 165 °F ± 5 (74 °C ± 3) in the environmental chamber for 5000 sound pulsation cycles as specified in 6.6.1 and 6.6.3.

5.3.24 Repeat 5.3.21 and 5.3.22.

5.3.25 Repeat 5.3.3 and 5.3.4.

5.3.26 Operate the complete system for 40 000 sound pulsation cycles as specified in 5.6.1 and 5.6.4.

5.3.27 Repeat 5.3.1, 5.3.2, 5.3.3, and 5.3.4.

***6. Laboratory Environmental Tests*—**Sound level output shall be measured during a minimum test period of 5 s according to the requirements of 4.3, 4.4, and 4.5 in the sequence under Data Acquisition 5.3.1 to 5.3.27. The unit shall then be examined. Any unit showing evidence of material physical weakness, displacement or ruptured parts, shall be considered to have failed. The environmental tests are listed in the recommended test sequence.

6.1 Vibration Test—A sample unit, (complete system) as mounted on the supports supplied, shall be bolted to the table of the vibration test machine and the test conducted as follows with the horn in operation as specified in 6.6.1.

6.1.1 RESONANCE SEARCH—Determine and record the resonant frequencies of the test item for each position (x-y-z axis) by slowly varying the frequency of applied vibration through 10 to 500 Hz with sufficient amplitude to excite the item. Resonance of components is determined by visual observation, strain gaging of components, observing signal interruptions of the electronic circuit, or a combination of the above (see Figure 2).

6.1.2 RESONANCE DWELL—Vibrate the test item for 30 min at a 10G (peak-to-peak) level at the most severe resonant frequency and at no more than three other significant resonant frequencies for 30 min, respectively (if they were found) along each axis (x-y-z) as determined in the Resonance Search in 6.1.1. For resonance frequencies below 27 Hz, the 10G (peak-to-peak) level may be allowed to decrease to a minimum of 2G (peak-to-peak) at 10 Hz to facilitate testing with equipment with inadequate capacity to maintain 10G (peak-to-peak) down to 10 Hz. If resonance frequency changes during this test, immediately record its time of occurrence and adjust frequency to maintain peak resonance. Record final resonant frequency.

6.1.3 VIBRATION CYCLING—Use a cycle time of 15 min to ascend to 500 Hz and descend to 10 Hz (see Figure 2). Vibration cycling will be along each axis (x-y-z) at 10G (peak-to-peak) above 27 Hz. Below 27 Hz, the G level may be allowed to decrease to a minimum of 2G (peak-to-peak) at 10 Hz to facilitate testing with equipment with inadequate capacity to maintain 10G (peak-to-peak) down to 10 Hz. The total cycling time for each axis is 3 h minus the time spent on that axis for the Resonant Dwell test in 6.1.2 (Reference MIL-STD-810B Method 514.1). During the final 15 min test period (on the axis checked last) connect the power to the horn and cycle it as per 6.6.1 to check that it is still operational.

TEST SCHEDULE

EQUIPMENT	APPLICABLE TESTS: RESONANCE SEARCH	RESONANCE DWELL	SINUSOIDAL CYCLING	TEST TIME SCHEDULE (PER AXIS): DWELL TIME AT EACH RESONANCE	SINUSOIDAL CYCLING TIME	SWEEP TIME 10-500-10 Hz
HORN AND SWITCH	x	x	x	30 MIN	3 H-LESS DWELL TIME	15 MIN

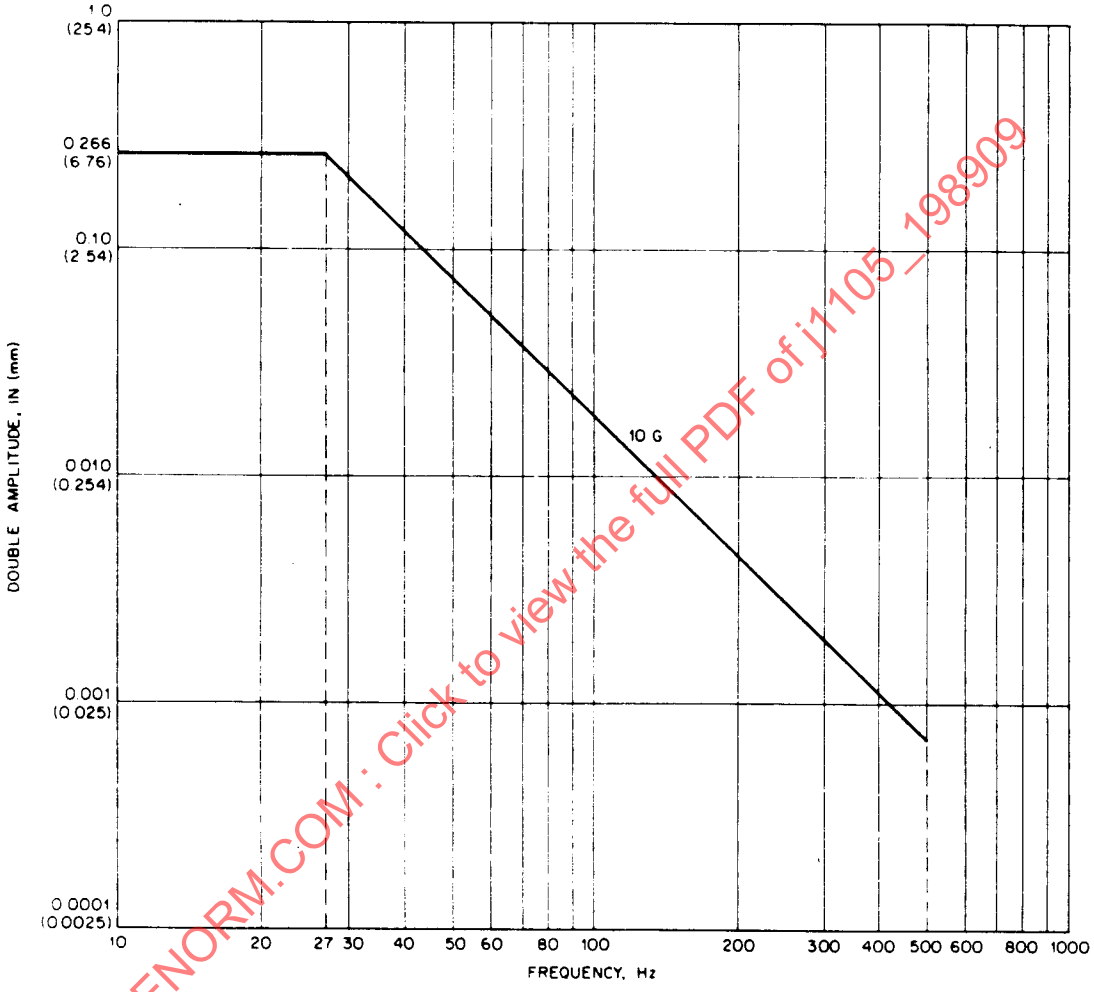

FIGURE 2—VIBRATION TEST

6.2 Rain Test—Mount a sample unit (complete system), not in operation, in its normal operating position with all drain holes open. Subject all exposed sides of the test item to simulated blown rain for at least 2 h with a precipitation rate of 0.1 in (0.0025 m) water per minute delivered at an angle of 45 deg from a nozzle with a solid cone spray. During the final 1 min of the blown rain test, connect the power to the horn and cycle it as per 6.6.1 to check that it is still operational. Allow horn to drain for 1 h and immediately make an operational check on the complete system.

6.3 Corrosion Test—Subject a sample unit (complete system), not in operation, to a salt spray (fog) test in accordance with ASTM B 117. Duration of test is to be 50 h consisting of two periods of 24 h exposure followed with 1 h drying time. Immediately following the second 1 h drying period, make an operational check on the complete system.

6.4 **Steam Test—**Direct a spray of steam-cleaning detergent compound (Trisodium Phosphate) at the horn bell or horn box louvers (whichever is applicable) from a nozzle located at 12 in (0.30 m) for a time period of 10 s, followed by a 30 s drain period. After 50 continuous cycles of steam application and draining, make an operational check on the complete system.

6.5 **Dust Test—**Mount a sample unit (complete system) in its normal operating position, at least 6 in (0.15 m) from any wall in a cubical box with inside measurements of 3 ft (0.90 m) on each side. The box shall contain 10 lb (4.536 kg) of AC dust of 50% fine and 50% coarse particles. For 5 h agitate the dust every 15 min for a 2 s period with compressed air or fan blower blasts, in a downward direction, to uniformly diffuse the dust throughout the cube. After completion of the dust test, make an operational check on the system. An alternate method of testing a sample unit may be in accordance with MIL-STD-810B Method 510.

6.6 **Life Cycle Test**

6.6.1 Operate the forward warning horn with sound pulsation cycles of 1 s on and 4 s off intervals of the actuation switch at a normal battery voltage of either 14 or 28 V:

6.6.2 5000 sound pulsation cycles at –40 °F ± 5 (–40 °C ± 3)

6.6.3 5000 sound pulsation cycles at 165 °F ± 5 (75 °C ± 3)

6.6.4 40 000 sound pulsation cycles at 77 °F ± 20 (25 °C ± 11)

7. ***Vehicle Application—***The job requirements, along with local, state, or national codes, should dictate whether a forward warning horn shall be used on mobile construction machinery.

8. ***General Requirements***

8.1 The forward warning horn shall be mounted on the equipment so that the sound is projected forward. It shall be protected or constructed as to withstand severe wear and tear, adverse weather, and unfavorable environmental conditions.

8.2 The sound of the forward warning horn shall be distinctive when compared to the sound of the back-up alarm that is on the vehicle.

9. ***General Comments***

9.1 It is recommended that persons technically trained and experienced in current techniques of sound measurement select the equipment and conduct the tests.

9.2 Proper usage of all test instrumentation is essential to obtain valid measurements. Operating manuals, or other literature furnished by the instrument manufacturer, should be referred to for both recommended operation of the instrument and precautions to be observed. Specific items include:

9.2.1 The type of microphone, its directional response characteristics, and its orientation relative to the ground plane and source of noise.

9.2.2 The effects of ambient weather conditions on the performance of all instruments (for example, temperature, humidity, and barometric pressure). Instrumentation can be influenced by low temperatures and caution should be exercised.

9.2.3 Proper signal levels, terminating impedances, and cable lengths on multi-instrument measurement systems.

9.2.4 Proper acoustical calibration procedure, to include the influence of extension cables, etc. Field acoustical calibration shall be made immediately before and after each test sequence.

9.3 A microphone windscreen may be used provided that the sensitivity change does not exceed ±0.5 dB to 5 kHz and ±2.0 dB to 12 kHz. It is recommended that measurements be made only when wind speed is below 12 mph (19.3 km/h).

9.4 The test power source impedance should closely approximate that of a 12 or 24 V battery.

PREPARED BY THE SAE BACK-UP AND FORWARD WARNING ALARM SUBCOMMITTEE
OF THE SAE CON-AG SOUND LEVEL COMMITTEE

SAE J1105 Reaffirmed SEP89

Rationale—Not applicable.

Relationship of SAE Standard to ISO Standard—Not applicable.

Application—This document establishes the following criteria for electrically operated, forward warning horns on mobile construction machinery:

a. Forward warning horn performance requirements
b. Measurement technique for horn performance requirements
c. Laboratory environmental tests
d. Horn activation on the vehicle

Reference Section

SAE J184 AUG87—Qualifying a Sound Data Acquisition System

SAE J994 MAR85—Alarm - Back-Up - Electric - Performance, Test, and Application

ANSI S1.1—1960 (R1976)—Acoustical Terminology

ANSI S1.2—1971 (R1976)—Physical Measurement of Sound

ANSI S1.4—1983—Specifications for Sound Level Meters

ANSI S1.11—1966 (R1976)—Specification for Octave, Half-Octave, and Third-Octave Band Filter Sets

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

Military Standard (MIL-STD-810B), Environmental Test Methods 510 and 514.1

ASTM B 117—Method of Salt Spray (Fog) Testing

AC Fine and AC Coarse Dust Available from AC Div. General Motors Corp.

Developed by the SAE Back-Up and Forward Warning Alarm Subcommittee

Sponsored by the SAE Con-Ag Sound Level Committee

The Engineering Society For Advancing Mobility Land Sea Air and Space®
INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

SURFACE VEHICLE RECOMMENDED PRACTICE

SAE J1105

REAF. SEP89

Issued 1975-05
Reaffirmed 1989-09

Superseding J1105 SEP89

Submitted for recognition as an American National Standard

HORN—FORWARD WARNING—ELECTRIC—PERFORMANCE, TEST, AND APPLICATION

Foreword—This Reaffirmed Document has not changed other than to put it into the new SAE Technical Standards Board Format.

1. Scope—This document establishes the following criteria for electrically operated forward warning horns on mobile construction machinery:

a. Forward warning horn performance requirements
b. Measurement technique for horn performance requirements
c. Laboratory environmental tests
d. Horn activation on the vehicle

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 J184 AUG87—Qualifying a Sound Data Acquisition System

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

ANSI S1.4—1983—Specifications for Sound Level Meters
ANSI S1.11—1966 (R1976)—Specification for Octave, Half-Octave, and Third-Octave Band Filter Sets

2.1.3 MILITARY PUBLICATION—U. S. Government, DOD SSP, Subscription Service Division, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094

Military Standard (MIL-STD-810B)—Environmental Test Methods 510 and 514.1

2.1.4 ASTM PUBLICATION—Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM B 117—Method of Salt Spray (Fog) Testing

QUESTIONS REGARDING THIS DOCUMENT: (724) 772-8512 FAX: (724) 776-0243
TO PLACE A DOCUMENT ORDER; (724) 776-4970 FAX: (724) 776-0790
SAE WEB ADDRESS http://www.sae.org

2.2 Related Publications

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

SAE J994 MAR85—Alarm—Back-Up—Electric—Performance, Test, and Application

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

ANSI S1.1—1960 (R1976)—Acoustical Terminology
ANSI S1.2—1971 (R1976)—Physical Measurement of Sound
ANSI S1.13—1971 (R1986)—Methods for the Measurement of Sound Pressure Levels

2.3 Other Publications

AC Fine and AC Coarse Dust Available from AC Div. General Motors Corp.

3. ***Forward Warning Horn System—***The forward warning horn system (complete system) for purposes of this document consists of a horn and an actuating switch (see Figure 1).

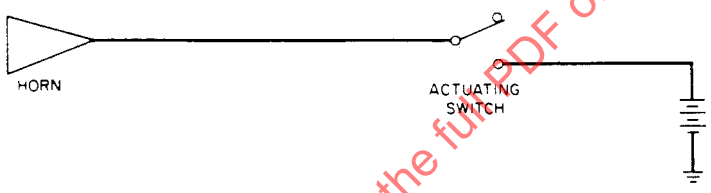

FIGURE 1—FORWARD WARNING HORN SYSTEM SCHEMATIC

4. ***Forward Warning Horn Performance Requirements—***The performance requirements apply at ambient temperature of 77 °F ± 20 (25 °C ± 11) and at normal operating voltage of a 14 or 28 V battery system (nominal 12 and 24 V battery systems) unless otherwise stated and measured as in 5.2 to 5.3.27.

4.1 The predominant sound frequency of the horn shall fall within the frequency range of 710 to 2800 Hz.

4.2 The sound level of the horn shall be measured according to 5.2 and shall be any of the following with tolerances as stated in 4.3, 4.4, and 4.5:

Type J - 117 dB(A)
Type K - 112 dB(A)
Type L - 107 dB(A)
Type M - 97 dB(A)
Type N - 87 dB(A)

4.3 The sound level shall meet the design Type or Types specified and not vary from the values in 4.2 by more than ±4 dB with a normal system voltage of 14 or 28 V.

4.4 The sound level shall not vary more than ±8 dB from the values given in 4.2 for both extremes of the operating voltage range 9.8 to 18.2 V and 19.6 to 36.4 V for 14 and 28 V systems respectively.

4.5 The sound level shall not vary more than ±8 dB from a baseline measurement (determined as specified in 5.3.15) at –40 °F ± 5 (–40 °C ± 3) and 165 °F ± 5 (74 °C ± 3) when the alarm is in the appropriate environmental chamber.

5. Laboratory Measurement Technique

5.1 Instrumentation and Test Facilities

5.1.1 A sound level meter which meets the Type 1 requirements of the ANSI S1.4-1983.

5.1.2 As an alternative to making direct measurements using a sound level meter, a microphone or sound level meter may be used with a magnetic tape recorder and/or a graphic level recorder or indicating meter providing the system meets the requirements of SAE J184.

5.1.3 A filter set which meets the Class II Octave Band requirements of ANSI S1.11-1966 (R1976).

5.1.4 A sound level calibrator

5.1.5 A temperature measuring system

5.1.6 A voltage measuring system

5.1.7 Vibration apparatus

5.1.8 Environmental chamber

5.1.9 Dust chamber

5.1.10 Rain, steam, and corrosion chamber

5.2 Measurements

5.2.1 The horn and a microphone shall be located in a free field 4 ft (1.2 m) above a horizontal reflecting plane or laboratory equivalent, with the microphone 4 ft (1.2 m) from the horn along its 0 deg axis. The 0 deg axis must be parallel to the horizontal reflecting plane. For determination of the sound levels in the appropriate environmental chamber for the extreme temperature tests, 5.2.5. (A free field is defined as an area with no vertical reflecting surface within 17 ft (5 m). A horizontal reflecting plane is defined as the finished concrete in a laboratory or the equivalent when conducting testing in the field.)

5.2.2 The ambient sound level, due to all sources other than the horn, shall be at least 10 dB lower than the A-weighted sound level of the alarm.

5.2.3 The sound level meter shall be set for slow response or equivalent and A-weighting network to check sound level.

5.2.4 The predominant sound level output shall be checked with octave band filters only to determine that the frequency is within acceptable limits. All other sound level checks shall be made using the A-weighting network.

5.2.5 The sound level shall be determined and recorded for the forward warning horn (Type J, K, L, M, or N) when it is actuated in the environmental test chamber at 77 °F ± 20 (25 °C ± 11) and at extreme temperature as specified in 4.5.

5.3 Data Acquisition

5.3.1 All data measurements will be taken during a minimum test period of 5 s operation at ambient temperature of 77 °F ± 20 (25 °C ± 11) and normal battery system voltage of 14 or 28 V unless either temperature or voltage is stated otherwise. The data must be correlated with performance requirements where specified. If

requirements are not met at any step in testing, a decision will be necessary to determine if testing should be continued.

5.3.2 Measure and record the predominant sound frequency of the horn. Correlate data with performance requirements in 4.1.

5.3.3 Measure and record the sound level of the horn. Correlate the data with performance requirements and tolerance from 4.3.

5.3.4 Measure and record the sound level change between extremes of operating voltage range 9.8 to 18.2 V and 19.6 to 36.4 V for 14 or 28 V systems respectively. Correlate the data with performance requirements and tolerance specified in 4.4.

5.3.5 Perform the vibration tests as specified in 6.1 to 6.1.3.

5.3.6 Repeat 5.3.3 and 5.3.4.

5.3.7 Perform rain tests as specified in 6.2.

5.3.8 Repeat 5.3.3 and 5.3.4.

5.3.9 Perform corrosion test as specified in 6.3.

5.3.10 Repeat 5.3.3 and 5.3.4.

5.3.11 Perform steam test as specified in 6.4.

5.3.12 Repeat 5.3.3 and 5.3.4.

5.3.13 Perform dust test as specified in 6.5.

5.3.14 Repeat 5.3.3 and 5.3.4.

5.3.15 Measure and record the sound level of the horn in the environmental chamber to obtain baseline data under conditions specified in 5.3.1.

5.3.16 Measure and record the sound level of the horn in the environmental chamber at –40 °F ± 5 (–40 °C ± 3) after the complete system has been at this temperature for at least 1 h immediately prior to this test. The sound level should be within ±8 dB of the baseline data measured in 5.3.15.

5.3.17 Measure and record the sound level of the horn in the environmental chamber at –40 °F ± 5 (–40 °C ± 3) for both extremes of the operating voltage range 9.8 to 18.2 V and 19.6 to 36.4 V for 14 or 28 V systems, respectively, after the complete system has been at the above temperature for at least 1 h immediately prior to the test. No specified sound level is required, but the horn is to be operational and register a reading on the meter above the existing ambient sound level.

5.3.18 Operate the complete system at –40 °F ± 5 (–40 °C ± 3) in the environmental chamber for 5000 sound pulsation cycles as specified in 6.6.1 and 6.6.2.

5.3.19 Repeat 5.3.16 and 5.3.17.

5.3.20 Repeat 5.3.15 for the environmental chamber that is to be used for the high temperature evaluation.

5.3.21 Measure and record the sound level of the horn in the environmental chamber at 165 °F ± 5 (74 °C ± 3), after the complete system has been at this temperature for 1 h immediately prior to this test. The sound level should be within ±8 dB of that measured in 5.3.20.

5.3.22 Measure and record the sound level of the horn in the environmental chamber at 165 °F ± 5 (74 °C ± 3) at both extremes of the operating range 9.8 to 18.2 V and from 19.6 to 36.4 V for 14 or 28 V systems, respectively, after the complete system has been at the above temperature for 1 h immediately prior to the test. No specified sound level is required, but the horn is to be operational and register a reading on the meter above the existing ambient sound level.

5.3.23 Operate the complete system at 165 °F ± 5 (74 °C ± 3) in the environmental chamber for 5000 sound pulsation cycles as specified in 6.6.1 and 6.6.3.

5.3.24 Repeat 5.3.21 and 5.3.22.

5.3.25 Repeat 5.3.3 and 5.3.4.

5.3.26 Operate the complete system for 40 000 sound pulsation cycles as specified in 5.6.1 and 5.6.4.

5.3.27 Repeat 5.3.1, 5.3.2, 5.3.3, and 5.3.4.

***6. Laboratory Environmental Tests*—**Sound level output shall be measured during a minimum test period of 5 s according to the requirements of 4.3, 4.4, and 4.5 in the sequence under Data Acquisition 5.3.1 to 5.3.27. The unit shall then be examined. Any unit showing evidence of material physical weakness, displacement or ruptured parts, shall be considered to have failed. The environmental tests are listed in the recommended test sequence.

6.1 Vibration Test—A sample unit, (complete system) as mounted on the supports supplied, shall be bolted to the table of the vibration test machine and the test conducted as follows with the horn in operation as specified in 6.6.1.

6.1.1 RESONANCE SEARCH—Determine and record the resonant frequencies of the test item for each position (x-y-z axis) by slowly varying the frequency of applied vibration through 10 to 500 Hz with sufficient amplitude to excite the item. Resonance of components is determined by visual observation, strain gaging of components, observing signal interruptions of the electronic circuit, or a combination of the above (see Figure 2).

6.1.2 RESONANCE DWELL—Vibrate the test item for 30 min at a 10G (peak-to-peak) level at the most severe resonant frequency and at no more than three other significant resonant frequencies for 30 min, respectively (if they were found) along each axis (x-y-z) as determined in the Resonance Search in 6.1.1. For resonance frequencies below 27 Hz, the 10G (peak-to-peak) level may be allowed to decrease to a minimum of 2G (peak-to-peak) at 10 Hz to facilitate testing with equipment with inadequate capacity to maintain 10G (peak-to-peak) down to 10 Hz. If resonance frequency changes during this test, immediately record its time of occurrence and adjust frequency to maintain peak resonance. Record final resonant frequency.

6.1.3 VIBRATION CYCLING—Use a cycle time of 15 min to ascend to 500 Hz and descend to 10 Hz (see Figure 2). Vibration cycling will be along each axis (x-y-z) at 10G (peak-to-peak) above 27 Hz. Below 27 Hz, the G level may be allowed to decrease to a minimum of 2G (peak-to-peak) at 10 Hz to facilitate testing with equipment with inadequate capacity to maintain 10G (peak-to-peak) down to 10 Hz. The total cycling time for each axis is 3 h minus the time spent on that axis for the Resonant Dwell test in 6.1.2 (Reference MIL-STD-810B Method 514.1). During the final 15 min test period (on the axis checked last) connect the power to the horn and cycle it as per 6.6.1 to check that it is still operational.