

(R) Vehicular Traffic Sound Signaling Devices

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1. **Scope—General**—This SAE Standard establishes the minimum operational life cycles, environmental requirements, and sound level output for traffic horns (electric) on new automotive vehicles. Test equipment, environment, and procedures are specified.

- 1.1 **Intended Usage and Life Expectation**—The horns meeting this specification are intended to be used on automotive vehicles, in defined climatic conditions and environments.

Any device functioning as a horn, is intended to perform its function, to this specification for at least 10 years or 250 000 km (150 000 miles).

For the purposes of this specification, this life shall be interpreted as:

Nominal Duty Cycles—50 000 cycles of 1.0 s ON, 4.0 s OFF. plus
Chirp Duty Cycles—40 000 cycles of 0.03 s ON, 1.97 s OFF. plus
Long Duty Cycles—200 cycles of 30 s ON, 60 s OFF; plus
Continuous Duty Cycles—5 cycles of 3.0 min. ON, 10 min. OFF.

These cycles shall be intermixed during testing as follows:

16 chirp duty cycles after each 20 nominal cycles;
2 long duty cycles after each 500 nominal cycles;
1 continuous duty cycle after the first long duty cycle and then every 10 000 normal cycles thereafter.

These duty cycles shall be modified for Combined Environment Testing as shown in the Combined Environment section.

2. References

- 2.1 **Applicable Publications**—The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue shall apply.

- 2.1.1 SAE PUBLICATIONS—Available from SAE, 400 commonwealth Dr. Warrendale PA 15096-0001

SAE J184—Qualifying a Sound Data Acquisition System
SAE J726—Air Cleaner Test Code

- 2.1.2 AIAG PUBLICATION—Available from Automotive Industry Action Group, 26200 Lahser Road, Suite 200, Southfield, MI 48034.

AIAG QS9000 Quality Systems

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

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

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- 2.1.4 ASTM PUBLICATION—Available from ASTM, 100 Barr Harbor Drive, West Conshohocken PA 19428-2959.
- ASTM B117-85—Testing for Salt Spray (Fog)
- 2.1.5 ECE PUBLICATION—Available from United Nations Economic Commission for Europe, Palais Des Nations, CH-1211, Geneva 10, Switzerland.
- ECE Regulation R28 - Uniform provisions concerning the approval of audible warning devices and of motor vehicles with regard to their audible signals.
- 2.1.6 EEC PUBLICATION—Available from European Economic Community Council
- EEC Directive of 70/388/EEC, 27 July 1970, relating to audible warning devices for motor vehicles.
- 2.1.7 IEC PUBLICATIONS—Available from International Electrotechnical Commission, 3, rue de Verambe, P.O. Box 131, 1211 Geneva 20, Switzerland.
- IEC Publication 60068-2-27—Basic environmental testing procedures Part 2: test Ea and guidance: Shock
IEC Publication 529: 1989—Degrees of protection provided by enclosures (IP Code)
IEC Publication 60068-2-64—Environmental testing Part 2: Test Fh: Vibration, broad-band random
IEC Publication 60651: 1979—Sound Level Meters
IEC Publication 60942: 1988—Sound Calibrators
- 2.1.8 ISO PUBLICATIONS—Available from ANSI, 11 West 42nd Street, New York, NY 10036-8002.
- ISO 10844: 1994—Acoustics - Test surface for road vehicle noise measurements
ISO 9001—Quality Systems
- 2.1.9 USCAR PUBLICATION—Available from USCAR, Suite 300, 1000 Town Center Bldg., Southfield Michigan, 48075.
- USCAR Connector Drawing 150-S-002-A01
- 2.1.10 US GOVERNMENT DOCUMENTS—Available from ???
- US EPA-40-CFR Ch1, Part 205 Test Surface
US FMVSS 302 Flammability
- 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 951361—Paper from the SAE Noise & Vibration Conference Report, P-291, Volume 2, SAE and ISO Noise Test Site Variability
- 2.2.2 ANSI PUBLICATION—Available from ANSI, 11 West 42nd Street, New York, NY 10036-8002.
- ANSI S1.40-1984—Specification for Acoustical Calibrators

3. Definitions—For purposes of this specification the following terms will be used:

3.1 Sound Signaling Device—A device that makes an audible sound of sufficient amplitude to alert people in the vicinity of the vehicle. For purposes of this document, the more common term “horn” will be used.

3.2 Horn Subsystem—The Horn Subsystem will be considered to include the horn or horn assembly, the horn attachments, the driver-controlled actuation device (steering column horn pad), any control devices between the actuation device and the horn (e.g., relay), and the related portions of any other horn actuation interfaces (e.g., electronic modules, wiring).

This document addresses only the horn or horn assembly as defined as follows. Unless otherwise specified, or defined by context, the term horn shall always be construed in the broadest context to include all pieces of the deliverable part, including, but not limited, to multiple horns, bracket(s), jumper harness(es), and connector(s).

3.3 Horn—A device for making an audible tone for signaling persons in the vicinity of the vehicle, or announcing the occurrence of some event on or in the vehicle. Where multiple horn units are supplied with a common bracket, the units will meet their requirements both individually and as a horn assembly. Excluded from this specification are sirens and other special signaling devices.

3.4 Disk Horn—A horn that produces the majority of its acoustical energy by use of a shaped metallic disc attached to the primary vibrating diaphragm.

3.5 Trumpet Horn—A horn that produces its acoustical energy by a diaphragm operating on an air column which is tuned to the diaphragm frequency. The air column (trumpet) is usually spiraled or otherwise bent to fit within the diameter of the basic horn.

3.6 Bracket—A connecting piece that interfaces between the audio-producing assembly (horn) and the vehicle mounting point. Due to acoustic and/or packaging reasons the bracket can consist of several parts or layers. The bracket is usually supplied as an integral part of the delivered horn, and may be an acoustic part of the horn system.

4. Test Environment

4.1 On-Vehicle

4.1.1 TEST EQUIPMENT DEFAULTS—The following instrumentation defaults shall apply where applicable:

Sound Levels shall be measured with a meter or measurement system that meets the requirements of ANSI S1.4 or IEC 60651. The meter shall be set for the A weighting scale and the Fast response. If a system other than a single sound level meter is used the system performance should be verified following the recommendations of SAE J184.

A microphone wind screen, if used must not affect the microphone response more than ± 1 dB for frequencies from 20 to 4000 Hz, and ± 1.5 dB from 4000 to 10 000 Hz.

When using a system that includes a periodic monitoring of the A-weighted sound level, a reading should be made at a time interval not greater than 30 ms.

At the beginning and at the end of a complete measurement session, but not less than once per day, the entire measurement system shall be checked by means of a sound calibrator that fulfills the requirements for sound calibrators of at least precision Class 1 according to IEC 60942. Without any adjustment, the difference between the readings of two consecutive checks shall be less than or equal to 0.5 dB. If this value is exceeded the results of the measurements obtained after the previous satisfactory check shall be discarded.

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Wind velocity shall be measured with an anemometer accurate to $\pm 10\%$ at 20 km/h (12 mph).

Measurement instruments, not otherwise specified, shall be accurate to one order of magnitude (1 decimal point) greater than the stated requirement.

Measurement instruments must be calibrated to a recognized standard as often as manufacturer recommends, but not less than once per year.

- 4.1.2 TEST ENVIRONMENT DEFAULTS—The test site shall be a smooth dry asphalt or concrete surface with an acoustic absorption of less than 0.10 in the frequency range from 400 to 1600 Hz. Surfaces that meet the requirements of ISO 10844 or the U.S. Federal EPA surface per 40 CFR Ch1 Part 205 will meet this requirement.

The location of the microphone within the test site shall also meet the following:

- a. Free of reflecting surfaces within 30.5 m,
- b. No one except microphone operator in test field,
- c. Wind velocity less than 20 km/h (12 mph).

Microphone shall be swept in a vertical path from a height of 0.5 m to 1.5 m to use the maximum sound pressure level occurring in that path.

Microphone shall be located at a distance of 7 m in front of, and on the longitudinal centerline of the vehicle.

Ambient sound level, including wind effects, coming from sources other than the vehicle being measured, shall be at least 10 dB(A) lower than the level of the horn(s) being tested. When engine noise makes the 10dB differential impossible, the test may be run and the measurement may be corrected according to the principles for combining decibel signal levels; provided the result is identified as having been corrected, the correction method is identified, and the observed data is provided.

Ambient temperature shall be between 13 °C and 30 °C. If the temperature is outside this range the test may be conducted if agreed to by all parties.

Measurements shall be made with the vehicle stationary and the engine running at idle. The engine shall have been running for 30 min prior to the test with no headlamp or other heavy electrical loads activated. For reference purposes the battery voltage shall be recorded before and after the test and shall be in the range of the vehicle manufacturer's specification.

NOTE— The requirement to test with engine running differs from the engine off requirement of ECE R28. Under this requirement, all horns are tested at the vehicle level with the horn powered as it would be on the road, regardless of whether it is DC, AC, or air powered. It provides a more accurate representation of how the horn will sound in actual usage, and makes the measurement independent of the nominal vehicle system voltage.

Duration of the horn activation shall not exceed 5 s, with not less than 20 s between activations.

The vehicle operator should be seated in/on the vehicle in normal operating position for a stationary vehicle. Enclosed vehicles should have the windows closed during the test.

4.2 Component Level

4.2.1 TEST EQUIPMENT DEFAULTS—The following instrumentation defaults shall apply where applicable:

Sound Levels shall be measured with a meter or measurement system that meets the requirements of IEC 60651. The meter shall be set for the A weighting scale and the Fast response.

Measurement instruments, not otherwise specified, shall be accurate to one order of magnitude (1 decimal point) greater than the stated requirement.

Measurement instruments must be calibrated to a recognized standard as often as manufacturer recommendations but not less than once per year.

The power supply shall be capable of supplying a continuous output current of at least 200% of the nominal current for the quantity of units being tested simultaneously. Output regulation shall not allow voltage to deviate more than 1.0 V from zero to maximum load (including surges) and shall recover 63% of its maximum excursion within 5.0 ms. Ripple shall not exceed 100 mV peak-to-peak.

4.2.2 TEST ENVIRONMENT DEFAULTS—Unless otherwise specified all tests shall be run at 13.0 V DC \pm 0.3V DC.

Source Resistance including all wiring to a "device under test" shall be not more than 0.1 Ohm. For single terminal, case grounded horns, the case ground path resistance must be included.

For horns that have been designed to operate on a different voltage or with a different circuit resistance, the voltage and resistance specified by the vehicle manufacturer shall be used.

Voltage measurements shall be made at, or within 80 mm, of the horn harness connector terminals.

Ambient temperature shall be between 13 °C and 30 °C.

Airflow up to 10 m/s is permitted.

Production wiring and connections shall be used. Terminals shall be changed periodically to assure terminal wear does not affect test results.

The horn shall be mounted with its production bracket to a sturdy base of mass at least 30 times the mass of the horn assembly. Mounting hardware and torque shall be consistent with the horn manufacturer's recommendations.

In the case of multiple horns mounted to a single bracket, each horn should be tested on its intended bracket with the other horn, but with only one horn connected. If necessary, individual horns may be rotated on the bracket such that their speaking axes are pointing toward the measurement microphone, as long as such rotation does not adversely influence their operation.

Alternatively a horn may be tested with the horn mounted on a standardized bracket defined by the horn manufacturer. Horns intended to be mounted to a bracket integral to the vehicle, shall be tested with the horn mounted on a standardized bracket defined by the horn manufacturer.

Sound Pressure Level measurements shall be conducted in a "Sound Attenuation Chamber" that is substantially anechoic in the frequency range of 20 to 2000 Hz. The materials and dimensions of the chamber shall be such that the sound pressure level will decrease 6 dB(A) at each doubling distance between the horn and the microphone, or which has been calibrated to simulate a free field environment.

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The horn and microphone shall face each other along the axis of maximum sound level at a distance of $2.0\text{m} \pm 0.1\text{ m}$.

Unless otherwise specified, maximum time of activation shall be 3 s, with at least 20 s OFF between activations. Shorter off times may be used at the option of the horn manufacturer.

- 4.3 Test Samples**—Component Level Test Samples shall be selected from normal production, at random from pieces that have been subjected to all normal processing and handling.

Test Samples shall be allocated among the various tests as indicated in the test matrix (see Appendix A).

Vehicle level tests shall be performed on vehicle(s) which are production intent in all areas that might affect emitted sound pressure level, and with horns that are production qualified.

- 4.4 Failure Determination**—A component level test failure will be determined should any sample fail to meet the specification, regardless of age or accumulated cycles.

Unless otherwise specified all test samples shall be checked for proper performance before and after each test segment, and after a complete test sequence. Performance shall be determined by a minimum of one (1) actuation of 15 s ON and 15 s OFF, and a minimum of three (3) actuations of 1 second ON and 1 s OFF. Sound Pressure Level shall be measured during any of the 1 s cycles. Failure shall be defined as a reduction in sound pressure level from the as-built condition of 5 dB(A) or greater, a change in fundamental frequency which results in the unit being outside its manufacturing tolerance by more than 20 Hz, or a significant change in perceived tone quality.

A vehicle level test failure will be determined should the vehicle fail to produce a sound level in the specified range.

- 5. On Vehicle Performance Requirements**—The Horn(s), when mounted to the vehicle in its designed position, and tested under the default test environment, shall produce a sound level of 93 to 104 dB(A) (see note) at a distance of 7 m. Sound pressure level must satisfy this requirement with all horns with which the vehicle is equipped operating. Optionally, a series of three readings may be taken and the average of the readings used for the determination.

NOTE— 112 dB(A) is the upper limit for vehicles sold under ECE R28. 104 dB(A) is the upper limit for vehicles sold in Brazil. 104 dB(A) is also the upper limit for vehicles sold in the U.S. based on converting the New York City Code to common dimensions. Vehicles destined for countries that do not subscribe to ECE R28 requirements must be tested to those countries' requirements. EEC 70/388 is equivalent to ECE R28. There are no nationally required measurements for U.S. or Canadian vehicles, except as recommended or stated previously.

6. Component Mechanical Requirements

- 6.1 Dimensional and Visual**—Parts shall be inspected for visual defects in appearance, manufacture, or assembly. Rattles and tightness of attachments shall be included in the inspection. Dimensions, mass, and finishes shall be as specified in the controlling documents.
- 6.2 Mounting**—Each Horn of a horn/bracket assembly shall withstand a torque of 8 Nm, applied about its axis in such a direction as would try to loosen the horn from its bracket.
- 6.3 Terminations**—The preferred connection for nominal 12 V DC systems shall meet the requirements of USCAR drawing 150-S-002-1-A01. For reference, portions of that drawing are reproduced in Appendix C. The polarity of the connector shall be Pin A = Gnd, Pin b = B+. For voltages other than 12 V DC, unique keying shall be incorporated into this connector.

Individual contacts of the termination interface shall withstand force of 50 N applied in each direction (push and pull) to dislodge the contact from its connector body or other attachment.

When terminals are contained in a connector body, the connector body shall withstand the following forces without permanent deformation or impairing the function or sealing of the connection system:

- a. A linear force of 50 N applied in any direction to the open end of the connector body. (Figure 1A)
- b. A torque of 2.5 Nm applied to the connector body around three mutually orthogonal axes. (Figure 1B).

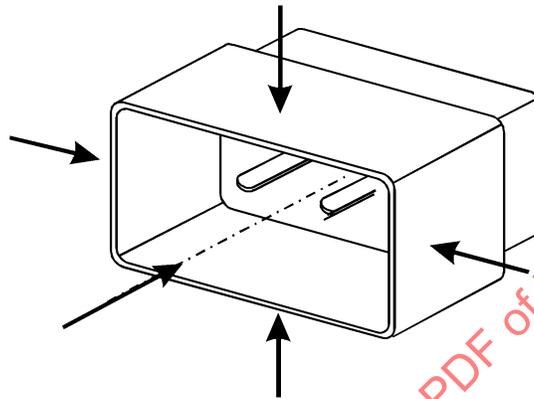


FIGURE 1A—FORCE TEST DIRECTIONS

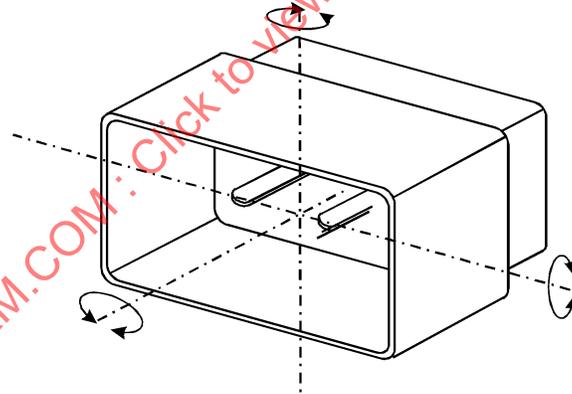


FIGURE 1B—TORQUE TEST DIRECTIONS

6.4 Materials—The horn or any supplied components shall not use any materials that are restricted or prohibited under any National or Local regulations, for the locations in which the using vehicle is expected to be sold or operated.

When intended for use inside the passenger compartment, materials used in the construction of any parts covered by this document shall meet the requirements of US FMVSS302.

6.5 Recycleability—Parts made of materials covered by any national regulations for recycleability shall be appropriately labeled.

6.6 Serviceability/Adjustments—The only service shall be by replacement of the horn or horn assembly. No customer or dealer adjustments shall be required or provided.

6.7 Identification—For part identification, the parts will include the following identification applied in such a manner as to be externally visible.

6.7.1 **CUSTOMER'S PART NUMBER**—Part number shall be applied as specified in the drawings. Additional manufacturer's designations may be included but shall not be applied in a way as to be confused with the final part number. In particular, manufacturer's identification of piece parts or sub-assemblies should be applied to be concealed or on less visible surfaces.

6.7.2 **DATE OF MANUFACTURE**—A "date code" shall be applied as a final operation indicating successful completion of tests. The date code shall include the year and day, shift, manufacturing line, and location as applicable. The date code may be in any format, but such format shall be publicly available.

6.7.3 **SOURCE**—The source of the part shall be identified by company name or logo.

6.7.4 **REGULATORY IDENTIFICATION**—Identification required by various governmental agencies shall be provided, (including but not limited to component type certifications and recycleability markings).

6.7.5 **FREQUENCY**—Each horn shall be marked with its nominal fundamental frequency, and or the musical note equivalent of the nominal fundamental frequency. In lieu of the actual fundamental frequency an abbreviated designation, such as *L* for *low* or *H* for *high*, is acceptable.

7. Component Electrical and Acoustic Requirements

7.1 Polarity, Connection Sequence—Horns shall be designed to have the polarity as specified by the drawing. The use of the mounting as a ground return shall be allowed only if specified by the drawing. In all devices, any exposed metallic case, shell or bracket is to be at vehicle ground potential, whether used as part of the energizing circuit or not.

The polarity of the preferred connector is specified in Appendix C.

The horn shall not be damaged by the sequence of connection to any of its terminals.

7.2 Operating Voltage Range—Horns shall be designed to work within specific ranges of voltage.

For horns designed to operate in nominal voltage systems other than 12 V DC, the voltage range shall be specified on the drawings or other documents. All references in this document, which is based on a nominal 12 V DC system, shall be adjusted by the drawings or other documents to the alternative voltage system values.

For 12 V DC nominal systems, horns shall be designed to work with voltages in the range of 9 to 16 V DC.

- a. 9.0 to 11.5 V DC Performance variation allowed
- b. 11.5 to 15.0 V DC Meet all parameters.
- c. 15.0 to 16.0 V DC Performance variation allowed

For this requirement, the unit will be operated 5 times at 13.5 V DC, noting tone quality (clear tone, fundamental frequency stability, and sound pressure level stability). The horn will then be operated 5 times at 11.7 V DC, and 5 times at 14.8 V DC, noting no appreciable difference in tone quality. The horn will then be operated 5 times at 9.0 V DC and 5 times at 16.0 V DC, noting tone quality. The horn will then be operated 5 times at 13.5 VDC noting tone quality. Each cycle shall be approximately 10 s ON for this test. OFF time shall be at the discretion of the supplier. Allowable performance variation shall be limited to a change of sound pressure level of ± 5 dB(A), and/or a change in fundamental frequency of ± 20 Hz. Tone stability is required, but some loss of tone clarity may be accepted.

- 7.3 Grounding, Insulation Resistance**—Except where the case is used as a ground return path, the case shall be isolated from any terminal by a minimum of 1 Mohm when tested at 500 V DC \pm 10 V DC for 60 s.
- 7.4 Parasitic Loads**—If designed to be supplied continuously with vehicle power and operated by a separate trigger signal or control connection, each unit's parasitic current shall be no more than allowed by the applicable drawing.
- 7.5 Readiness, Response Time**—The horn shall be in a constant state of readiness. It shall not require any wake-up or warm-up time. When tested at a component level, at 18 °C to 28 °C, the horn shall produce an audible output upon application of a signal of at least 25 ms duration at 9 V DC. Full sound pressure level shall be produced upon application of 13 V DC for greater than 200 ms. For this test the sound pressure meter should be set to the *Impulse* setting if available.
- 7.6 Current**—Horns shall be nominally rated at no greater than 6.0 A per horn at 13.0 V DC. Actual maximum current shall be as specified on the drawing. For three-terminal horns, the control (trigger) circuit maximum current shall be as specified on the drawing.
- 7.7 Fundamental Frequency**—Fundamental frequency of a horn shall be as specified on the drawing.
- 7.8 Sound Pressure Level and Harmonics**—Sound pressure level and harmonic structure of each horn shall be certified to meet the applicable requirements of United Nations Economic Commission for Europe Regulation Number 28 (ECE R28) as amended.
- Horns so qualified must carry the appropriate markings.
- 7.9 Variability**—Each horn shall produce a steady tone. For this requirement, the horn shall be operated at an ambient temperature between 13 °C and 30 °C and a nominal voltage of 13 V DC for 5 cycles of 1 min ON and then sufficient OFF time to return to ambient temperature. During the ON time, the fundamental frequency and sound pressure level shall be subjectively evaluated as being essentially unvarying.
- 7.10 Electromagnetic Compatibility**—The horn shall not produce energy that would interfere with any other components or systems in the vehicle. Specific requirements shall be specified on the drawing or in related documents.

8. Component Environmental Requirements

- 8.1 Temperature**—The horn shall be designed to withstand storage temperatures of -40 °C to $+100$ °C. This requirement shall be tested by exposing the horn to 5 cycles of temperature as follows:
- 30 min rising from ambient to $+100$ °C,
 - 47 h (\pm 30 min) dwell at $+100$ °C,
 - 3 h max dropping to -40 °C,
 - 47 h (\pm 30 min) dwell at -40 °C
 - 1 h max rising from -40 °C to ambient.

At completion of each cycle, the horn shall operate without degradation when actuated 5 times at 13 V DC for 2s ON and 10 s OFF.

- 8.2 Thermal Shock**—The horn shall operate without degradation after exposure to 10 cycles of thermal shock of $+85$ °C to -40 °C and back to $+85$ °C, with a minimum dwell time at each temperature of 1 h and a maximum transition time of 2 min.

8.3 Humidity—Two separate tests shall be performed. Operating Humidity shall be performed as part of the test matrix sequence. Non-Operating Humidity shall be performed on a separate group of 10 horns as specified as follows.

8.3.1 HUMIDITY, OPERATING—The horn shall operate in high humidity environments. For this test, Disk horns shall be mounted with the plane of the diaphragm vertical; Trumpet horns shall be mounted with the plane of the diaphragm horizontal and the trumpet below the motor housing. The horn shall be placed in a chamber stabilized at 38 °C and 95% relative humidity for 10 days. For 12 h per day the horns shall be energized for 3s every 10 min.

8.3.2 HUMIDITY, NON-OPERATING—The horn shall operate without degradation after sitting dormant in high humidity environments.

Terminal resistance and functional characteristics will be measured before and after test. Five (5) of the horns will be mounted with the plane of the diaphragm horizontal and the diaphragm below the motor housing. Five (5) of the horns will be mounted with the plane of the diaphragm vertical, and if a trumpet is included, axis of the mouth of the trumpet shall point between vertically down and 45 degrees from vertically down. The horns will be placed in a chamber with 95% humidity at ambient temperature, raised to 40 °C at maximum speed and maintained for 4 h. Increase temperature to 80 °C in 40 min and maintain 4 h. Decrease temperature to 40 °C in 40 min and repeat cycle for a total of 10 cycles without operating the horn.

8.4 Frost—The horn shall operate without degradation after being subjected to frost. For this test the horn shall be stabilized for 4 h at –20 °C, then transferred to 10 °C and 95% RH. After 10 min operate 20 times for 3 s ON and 10 s OFF. Repeat the test 5 times on each horn.

8.5 Vibration—The horn, when tested with its intended bracket, shall withstand random vibration in each of 3 mutually perpendicular axes, without damage or degradation of performance. The direction of one of the 3 axes shall be normal to the bracket mounting plane. Optionally, under customer direction, for validating horns that include brackets, the horns may be tested only in vehicle mounting position. During this test the horn(s) is to be connected to a representative harness connector(s) so that it can be operated during the test.

Perform test according to IEC 60068-2-64, random vibration, method 1 or 2. The vibration shall be from 10 to 1000 Hz, applied for 8 h in each axis (24 h total) with power levels and spectral density specified by the following:

RMS acceleration value = 20.9 m/s²

TABLE 1—POWER SPECTRAL DENSITY

Frequency	$\frac{(m/s^2)^2}{Hz}$
10	7
50	3.5
60	1.75
1000	0.06

As a development test only, production intent units (with bracket) shall be evaluated for their resonant frequency.

Each tested horn shall be checked after such test for any rattles, noise, or lack of original clear tone when operated 20 times at 13 V DC, 3 s ON and 10 s OFF.

8.6 Shock/Drop—The horn with its intended bracket shall withstand the shock loading encountered during shipping and handling, installation, and during normal operation. Each tested horn shall be checked after such test for any rattles, noise, or lack of original clear tone when operated 20 times at 13 V DC, 3 s ON and 10 s OFF.

8.6.1 **SHOCK**—The horn shall withstand 3000 shocks in each direction along each of the 3 primary axes (9000 shocks total) without visible damage or degradation of performance. Each shock shall be 20 g peak acceleration, half sine wave of 18 ms duration tested in accordance with IEC 68-2-27. Optionally, under customer direction, for validating horns that include brackets, the horns may be tested only in vehicle mounting position.

8.6.2 **DROP**—The horn, in its delivered state with bracket, shall be capable of withstanding a 1.0 m drop onto a solid concrete floor when released in 6 orthogonal directions. When no obvious damage is visible, no degradation of performance is allowed. Minor cosmetic damage is acceptable.

8.7 Contaminants—The horn shall withstand the following contaminants with the unit mounted both with the diaphragm vertical (trumpet mouth opening down if applicable), and with the diaphragm horizontal, trumpet or disk below the diaphragm.

a. Gasoline (unleaded)	Commercial
b. Diesel Fuel	Commercial
c. Engine Oil	Commercial 10W30
d. Power Steering Fluid	Commercial
e. Ethylene Glycol	Commercial 50% by volume
f. Windshield Washer Fluid	All Commercial types
g. Automatic Transmission Fluid	All Commercial types
h. Car Wash Detergents	All Commercial types
i. Brake Fluid	All Commercial types

Each contaminant will be tested on a different sample. A connector representative of the harness connection will be installed prior to and during these tests.

Test is to be accomplished by pouring an adequate amount of material over the unit to completely coat the appropriate surfaces. Allow the unit to stand for 24 h.

The sound of the horn shall be clear and the allowable drop in sound pressure level shall be less than 5 dB(A). The horn shall function properly when subjected to 20 actuations of 3 s ON, 10 s OFF at 13 V DC. There shall be no loss of electrical or mechanical integrity that could result in shorting, shorting to ground, or unintentional operation of the horn.

8.8 Corrosion—Horns shall be capable of operating in regions of the world where corrosive salt environments exist. Horns are to be tested in accordance with ASTM B 117 for 168 h. Each hour the horn shall be operated 20 cycles of 1 s ON and 4 s OFF during this test.

Following the exposure, visible corrosion (red rust) shall not be greater than 10% of the exposed metal surface.

Following the exposure, there shall be no more than 5 dB(A) loss in sound pressure, or significant change in perceived tone quality.

8.9 Dust—Horns shall be capable of operating in regions of the world where dust environments exist. Horns are to be tested for 8 h in a chamber per IEC 529-IP6 except with 6 kg/m³ concentration of dust conforming to SAE J726 Coarse Grade. Agitate the dust for 5 s in each 20min in such a manner that the dust is uniformly diffused throughout the chamber. Operate the horn(s) 1 s ON, 29 s OFF throughout the test.

8.10 Water Impingement—The horn shall not be damaged by splash from rain or road, or by pressure washers.

At end of test, the horns shall function without degradation when operated 5 times, 1 s ON, 29 s OFF. The horns shall be disassembled after these tests. There shall be no evidence of water intrusion into the motor housing or sealed connection interfaces.

8.10.1 **SIMULATED RAIN ENVIRONMENT**—The horn shall be subjected for 5 days to a simulated rain environment. The horn, if a trumpet type, shall be mounted with the trumpet mouth down. The environment shall consist of either nozzles aimed at 5 surfaces (not the trumpet mouth), or a moving array of nozzles oscillating at no less than 5 s/cycle, that will wet the same surfaces. Water must not be directed into the trumpet mouth. The spray shall operate for 2 h, and rest for 10 h, repeated twice per day for 5 days. The horn is to be operated continuously for 1 s ON and 29 s OFF during the first hour of each spray cycle.

8.10.2 **HIGH PRESSURE WASHER**—The horn shall withstand, without damage or degradation, a water jet of 8 to 10MPa, 14 to 16 l/min, for 120 s aimed at all surfaces and edges, except the trumpet mouth, from a distance of 0.5 m and using a 30 degree fan nozzle.

8.11 Water Immersion—The horn shall not be damaged by full contact with water. This shall be tested by an immersion test. This test shall be accomplished by immersion to 30 cm in 5% salt water at ambient temperature for 5 min. At the conclusion of the test the horn shall operate without degradation when actuated 20 times for 3 s ON. For trumpet style horns the horns shall be immersed with the mouth pointing down.

As a development test the horn should be temperature conditioned for 1 h in air at 85 °C, then immersed to 30cm in 5% salt water at 0 °C for 1 h, and followed by 1 h at ambient. This sequence shall be repeated 25times. The horn should be operated at least once prior to each heating cycle to verify functionality and tone. The horn shall be disassembled and inspected for water entry. Entry of water into the horn or any sealed connection shall be evaluated by the customer.

8.12 Altitude—The horn shall be designed to work at all altitudes from –85 m to +3700 m relative to mean sea level. This requirement need be demonstrated only once per horn family. Demonstration shall consist of operating a horn in a pressure controlled chamber. The horn sound shall be subjectively evaluated for clear tone with the chamber pressure set at 56 kPa and again with the pressure set at 106 kPa.

8.13 Combined Environments—Reliability and durability shall be demonstrated by subjecting a minimum of 22random sample of horns/assemblies to a life test by operating the horn using the usage profile specified in 1.1 Intended Usage and Life Expectation, and the environmental profile defined by Appendix B. The demonstration will be accomplished by running the samples to failure, or three (3) times life, whichever comes first.

Six (6) of the samples shall be mounted with the plane of the diaphragm horizontal, trumpet/disk below. Six (6) of the samples shall be mounted with the plane of the diaphragm vertical and centerline of bracket horizontal, (if trumpet type, trumpet mouth vertical and below centerline). Six (6) of the samples shall be mounted with the plane of the diaphragm vertical and centerline of bracket vertical, (if trumpet type, trumpet mouth vertical and below centerline). Four (4) of the samples shall be mounted, at supplier option, in any of the orientations described previously. One (1) horn of each orientation (3total) shall be properly connected, but shall be operated only at the beginning and end of test to verify performance. End of test for the three silent horns shall be defined as the length of time for the other horns to reach one times life. All other horns shall be operated in accordance with the usage profile.

The test schedule shall be modified, if necessary, to assure that:

- a. No continuous duty cycles occur above 75 °C, and
- b. At least one long cycle group occurs during a 65 °C segment, and
- c. At least one long cycle group occurs during a –40 °C segment.

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The test schedule may be modified, at the supplier's option, to increase the OFF time between cycles at any temperature above 50 °C.

Vibration during this test shall be random with the Power Spectral Density (PSD) according to 8.5 Vibration, but with a maximum power level of 1 g RMS.

Sound Pressure measurements and tone quality evaluations shall be made at least every 10 000 Normal Duty Cycles, when the temperature is at ambient, and shall include an evaluation of both chirp and normal activation modes.

For purposes of this test, failure shall be defined as:

- a. A loss of greater than 5 dB in sound pressure level
- b. A change in frequency which results in a fundamental frequency outside the normal manufacturing tolerance of greater than 5 Hz.
- c. Failure of the horn to operate for more than 5 times in succession at any time during the demonstration.

9. Validation

9.1 Development Testing

9.1.1 **PURPOSE**—Development tests are tests used to evaluate specific areas of design. They are a tool for evaluating original designs, design alternatives, proposed improvements, cost reduction proposals, or for field problem analysis. Development tests may be severe. Development tests often accelerate testing by exaggerating specific environments. Failures under a development test are expected. Such failure does not necessarily indicate inadequacy of design. Any failures must be evaluated and the results and any action documented to the customer. Any development tests included herein are for reference only and are not a part of the part approval. Additional development test requirements will vary from customer to customer.

9.2 **Design Validation and Durability Testing**—Validation tests are those tests required to demonstrate that the component or system of components can meet the requirements of this specification for the life of the component. These validation tests must be satisfactorily completed before use on a production vehicle.

Design validation shall consist, unless otherwise specified, of the tests stated in this specification. Sample sizes and test sequence shall be in accordance with the test matrix of Appendix A.

Where a basic horn family has been validated as separate components, the test schedule for assemblies consisting of those validated components, together with brackets and/or jumper harnesses may be abbreviated to include only those parameters related to the assembly differences.

When new parts differ from parts previously tested and fully qualified under this specification by details that affect only mounting and orientation, and which can be shown analytically to not affect performance, re-testing under this paragraph may be modified or waived.

9.3 **Annual Re-validation/Re-certification**—At least once per year, a minimum of 10 samples shall be placed on an automated cycle test, and cycled until failure, or three (3) times life, whichever comes first. The test shall be the same as that specified for the Combined Environment as specified above.

10. **Reliability**—The Reliability requirements have been incorporated in the testing specified previously. No additional testing is required.

11. **Quality Assurance**—The supplier shall be certified to a system recognized and accepted by the customer (e.g., ISO 9001, AIAG QS 9000).

12. Authority and Revision History

12.1 Authority—This document has been developed by the SAE Sound Signaling (Horn) sub-committee of the SAE Motor Vehicle Sound Level Committee. It is intended to be a common specification that will meet the requirements of vehicle manufacturers and governmental agencies worldwide.

PREPARED BY THE SAE SOUND SIGNALING (HORN) SUBCOMMITTEE
OF THE SAE MOTOR VEHICLE SOUND LEVEL COMMITTEE

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APPENDIX A

TEST MATRIX AND TEST PROFILES

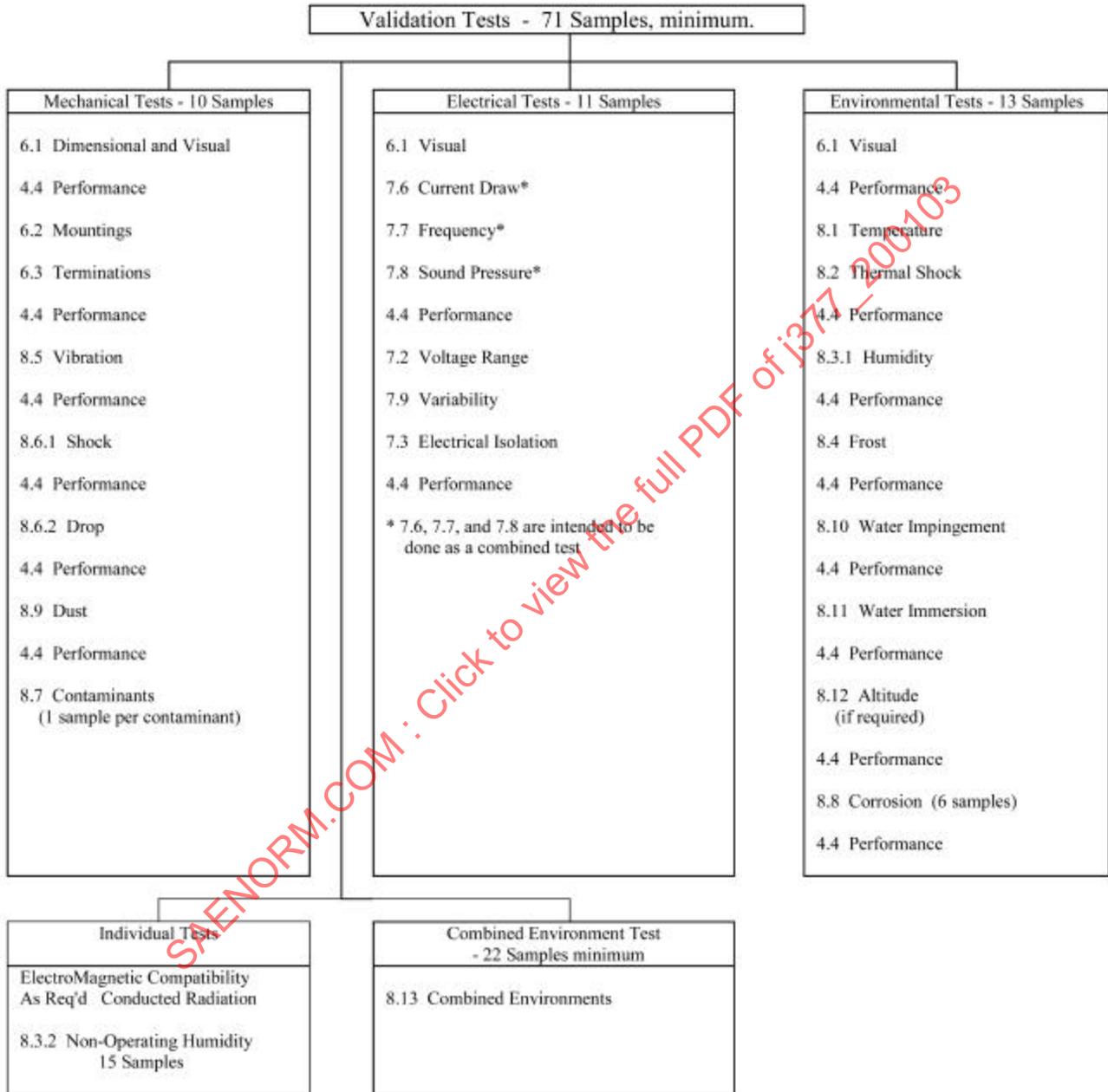


FIGURE A1—TEST MATRIX AND TEST PROFILES

APPENDIX B

COMBINED ENVIRONMENT PROFILE

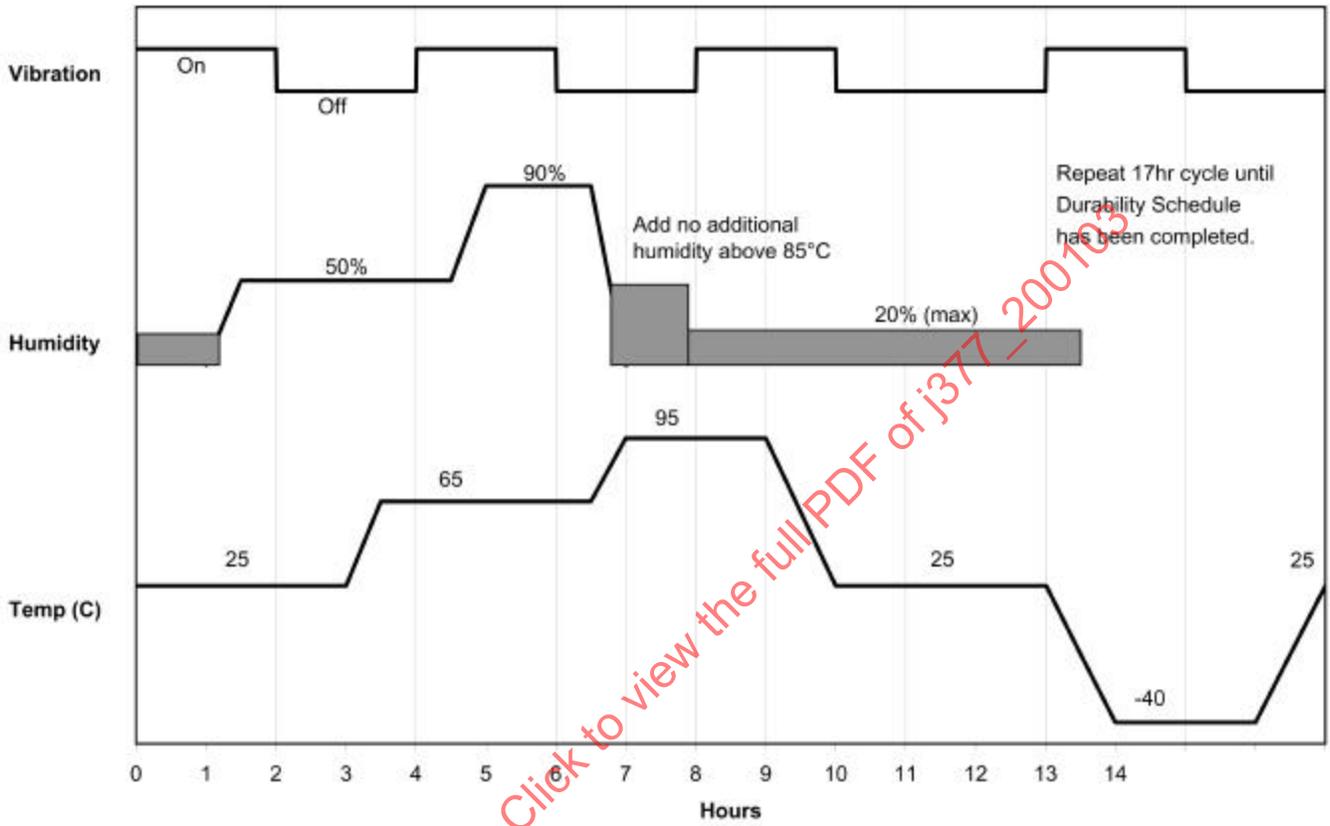


FIGURE B1—COMBINED ENVIRONMENTAL RELIABILITY TEST SCHEDULE