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INTERNATIONAL
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SURFACE VEHICLE STANDARD

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An American National Standard

(R) Measurement of Noise Emitted by Accelerating Highway Vehicles

1. ***Scope***—This SAE Standard is equivalent to ISO Standard 362 - 1997 except for the differences detailed in Appendix A, and includes the modifications adopted by WP 29 in ECE R51 Revision 1 and EEC 92/97 and EEC 96/20.

This document specifies an engineering method for measuring the noise emitted by accelerating highway vehicles of all types (except motorcycles) in intermediate gears with full utilization of the available engine power.

The method is designed to meet the requirements of simplicity and reproducibility of results under realistic vehicle operating conditions.

Measurements relate to operating conditions of the vehicle which give the highest noise level consistent with urban driving and which lead to reproducible noise emissions. Therefore, an acceleration test at full throttle from a stated engine or vehicle speed is specified.

The test method calls for an acoustical environment which can only be obtained in an extensive open space. Such conditions can usually be provided for:

a. Measurements at the manufacturing stage
b. Measurements at official testing stations

Measurements must be carried out in an acoustical environment which fulfill the requirements stated in this document. It should be noted that spot checking of vehicles chosen at random can rarely be made in an ideal acoustical environment. If measurements have to be carried out on the road in an acoustical environment which does not fulfill the requirements stated in this document, it should be recognized that the results obtained may deviate appreciably from the results obtained using the specified conditions.

The results obtained by this method give an objective measure of the noise emitted under prescribed conditions of test. However, it is necessary to consider the fact that the subjective appraisal of the annoyance of different classes of motor vehicles is not simply related to the indications of a sound level meter. The motorcycles are covered in other SAE documents that prescribe an operating mode that is more representative of actual use.

2. References

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

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

SAE J184—Qualifying a Sound Data Acquisition System
SAE J1349—Engine Power Test—Spark Ignition and Diesel
SAE 951361—Paper from the SAE Noise & Vibration Conference Report, P-291, Volume 2, SAE and ISO Noise Test Site Variability

2.1.2 ANSI PUBLICATIONS—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
ANSI S1.40-1984—Specification for Acoustical Calibrators

2.1.3 ECE PUBLICATIONS—Available from United Nations Economic Commission for Europe, Palais Des Nations, CH-1211, Geneva 10, Switzerland.

ECE R51—Uniform Provisions Concerning the Approval of Motor Vehicles Having at Least Four Wheels with Regard to Their Noise Emission

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

IEC Publication 60651: 1979—Sound Level Meters
IEC Publication 60942: 1988—Sound Calibrators

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

ISO 362-1981—Acoustics—Measurement of noise emitted by accelerating road vehicles—Engineering method
ISO 1176-1974—Road vehicles—Masses—Vocabulary and Codes
ISO 1585-1982—Road vehicles—Engine test code—Net power
ISO 3833-1977—Road vehicles—Types—Terms and definitions
ISO 10844:1994—Acoustics—Specification of test tracks for purpose of measuring noise emitted by road vehicles

2.1.6 EUROPEAN ECONOMIC COMMUNITY - EEC REFERENCE—Available from European Commission, Rue de la Loi 200, B-1049 Brussel, Belguim.

EC- 92/97/EEC—Council Directive of 10 November 1992 from the Official Journal of the European Communities
EC- 96/20/EEC—Council Directive of 27 March 1996 from the Official Journal of the European Communities

*3. Definitions—*For the purpose of this document, the following definitions apply.

3.1 Automatic Downshift—A gear change to a lower gear (higher numerical ratio) which occurs outside the control of the driver.

NOTE— An automatic downshift may be initiated, for example, by a change of pressure on or position of the accelerator control, thereby activating a special program which effects downshifts to gears which are lower than those normally used in urban driving.

3.2 Forced Downshift—A gear change to a lower gear (higher numerical ratio) which can be initiated at the will of the driver. A forced downshift may be initiated, for example, by a change in the position of the throttle pedal, thereby activating an external switch which affects the downshift.

3.3 Kickdown—A forced downshift to the lowest possible gear (first or low gear).

3.4 Intermediate Result—The value calculated from the test series measurements and used to determine the reported value.

3.5 Curb Mass—Complete shipping mass of a vehicle fitted with all equipment necessary for normal operation plus the mass of the following elements:

a. Lubricants, coolant (if needed), washer fluid,
b. Fuel (tank filled to at least 90% of the capacity specified by the manufacturer),
c. Optional equipment if included as standard parts for the vehicle such as: spare wheel(s), wheel chocks, fire extinguisher(s), spare parts, and tool-kit.

NOTE—The definition of curb mass may vary from country to country, but in this document, it refers to the definition contained in ISO 1176. The mass values listed are US equivalent to the metric requirement: 1 Metric Tonne = 1.1 tons.

3.6 Rated Engine Speed, S—That engine speed at which the engine develops its rated maximum net power as stated by the manufacturer.

NOTE—The test engine speed for governed engines is typically the maximum full load governed speed which is up to 500 rpm higher than the engine speed at maximum net power. The use of net rated power speed or maximum governed speed may vary from one regulatory group to another.

3.7 Vehicle Categories

3.7.1 Category M—Motor vehicles with at least four wheels used for the carriage of passengers:

M1—Vehicles used for the carriage of passengers and comprising no more than eight seats in addition to the driver's seat.
M2—Vehicles used for the carriage of passengers and comprising more than eight seats in addition to the driver's seat, and having a maximum mass not exceeding 5.5 tons.
M3—Vehicles used for the carriage of passengers and comprising more than eight seats in addition to the driver's seat, and having a maximum mass that exceeds 5.5 tons.

3.7.2 Category N—Motor vehicles with at least four wheels used for the carriage of goods:

N1—Vehicles used for the carriage of goods and having a maximum authorized total mass not exceeding 3.85 tons.
N2—Vehicles used for the carriage of goods and having a maximum authorized total mass exceeding 3.85 tons but not exceeding 13.2 tons.
N3—Vehicles used for the carriage of goods and having a maximum authorized total mass exceeding 13.2 tons.

4. Instrumentation

4.1 Instrumentation for Acoustical Measurements—The sound level meter system including the windscreen recommended by the manufacturer shall meet Type 1 or Type S1A requirements of ANSI S1.4-1983. A microphone windscreen may be used, provided that it does not affect the microphone response by more than ±1dB for frequencies from 20 to 4000 Hz and ±1.5 dB for frequencies from 4000 to 10 000 Hz.

The sound level meter shall be set for the frequency weighting “A” and the time weighting “F.”

The calibration of the sound level meter shall be checked and adjusted according to the manufacturer's instructions using a sound level meter calibrator meeting the requirements of ANSI S1.40-1984 (for example, a pistonphone) at the beginning of the measurements and rechecked and recorded at the end of them. (See 7.3.4)

If the readings of the sound level meter obtained from these calibrations change by more than 0.5 dB during a series of measurements, the test shall be considered invalid.

Compliance of the sound level meter with ANSI S1.4-1983, Type 1, shall be verified at intervals of not more than 2 years. The compliance of the sound calibration device with the requirements of ANSI S1.40-1984 shall be verified once a year. These compliance verification evaluations shall be performed by a laboratory which is authorized to perform calibrations traceable to the appropriate standards.

As an alternative to making direct sound level measurements using a sound level meter, a microphone or sound level meter may be used with a magnetic tape recorder, or other indicating instrument providing the system is in conformance with SAE J184. 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.

4.2 Instrumentation for Speed Measurements—Engine speed and vehicle speed shall be measured during the approach with instruments having an accuracy of 2% or better at the speeds required for the measurements being performed.

4.3 Other Instrumentation—The meteorological instrumentation used to monitor the environmental conditions shall include the following:

a. A temperature measuring device which shall be accurate within ±1 °C.
b. A wind speed measuring device which shall be accurate within ±1.0 m/s.

5. Acoustical Environment, Meteorological Conditions, and Background Noise

5.1 Test Site—The test site shall be such that hemispherical divergence exists between the noise source and the microphone to within ±1dB.

This condition is deemed to be satisfied if the following requirements are met:

a. Within a radius of 50 m around the center of the track, the space shall be free of large reflecting objects such as fences, rocks, bridges, or buildings. (See Figure 1.)
b. The entire test track and the surface of the site up to 10 m from the center “0” of the track shall consist of concrete, non-porous or sealed asphalt, or similar hard material and be free of absorbing materials such as powdery snow, or ashes. (See Figure 1.)
c. When this procedure is used for compliance and type approval of vehicle sold in non-US markets, the surface must be constructed according to the requirements given in ISO 10844. The surface shall also meet the performance criteria contained in ISO 10844.

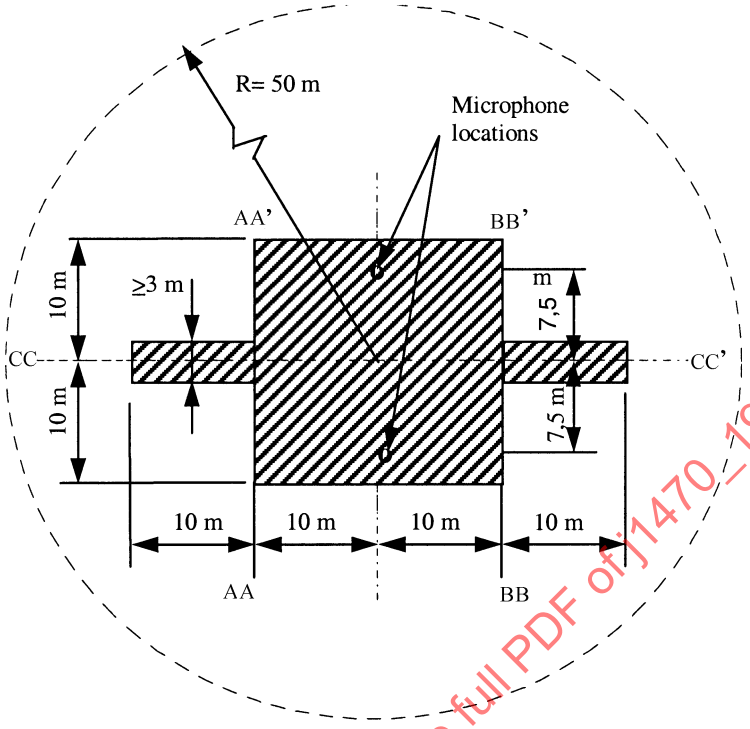

FIGURE 1—TEST SITE DIMENSIONS - SHADED AREA ("TEST AREA") IS THE MINIMUM AREA TO BE COVERED WITH A SURFACE COMPLYING WITH ISO 10844.

d. In the vicinity of the microphone, there shall be no obstacle that could influence the acoustical field and no person shall be between the microphone and the noise source. The meter observer shall be positioned so as not to influence the meter reading.

A primary concern regarding the test site is flatness of the measurement area. The measurement area shall be flat within ±0.05 m, particularly in that portion of this area between the vehicle path centerline and the microphone location and to a distance of 15 m before and after the intersection of the vehicle path and the perpendicular to it passing through the microphone location. (See Figure 1.)

5.2 Meteorological Conditions—The meteorological instrumentation should be positioned adjacent to the test area at a height representative of the site, except the specific location as follows.

It is recommended that the measurements be made when the ambient air temperature is within the range from 0 °C to 40 °C.

It is recommended that tests should not be carried out if the wind speed, including gusts, at microphone height exceeds 5 m/s, during the sound measurement interval.

It is recommended that a value representative of air temperature, wind speed and direction, relative humidity, and barometric pressure, and track temperature be recorded during the sound measurement interval.

5.3 Background Noise—It is recommended the background noise (including any wind noise) be 15 dB(A) below the sound produced by the vehicle under test, but it shall be at least 10 dB(A)

6. Test Procedure

6.1 Microphone Positions—The distance from the microphone positions to the reference centerline CC (see Figure 1) on the test track shall be 7.5 m ± 0.05 m.

The microphone shall be located 1.2 m ± 0.02 m above the ground level. Unless otherwise indicated by the manufacturer of the sound level meter, its reference axis for free field conditions (see ANSI S1.4-1983) shall be horizontal and directed perpendicularly towards the path of the vehicle (centerline CC) on the microphone line.

6.2 Number of Measurements—At least four measurements shall be made on each side of the vehicle.

6.3 Readings to be Taken—The maximum sound pressure level indicated during each passage of the vehicle when operated as specified in 6.5.1 shall be recorded. If a sound peak obviously out of character with the general sound level is observed, the measurement shall be discarded.

The results shall be considered valid if the differences between four consecutive measurements made on the side of the vehicle which gives the highest sound pressure level do not exceed 2 dB. If not, additional runs shall be made until four consecutive measurements on either side are within 2 dB of each other. The spread of results between runs may be reduced if there is a 1-minute wait, at idle in neutral, between runs.

Average the results of each side separately. The intermediate result is the higher of the two averages.

The final reported value for the vehicle is as indicated as follows:

a. For vehicles in categories M1 and N1 tested in a single gear: the intermediate result.
b. For vehicles in categories M1 and N1 tested in two gears: the arithmetic average of the intermediate results for each gear.
c. For vehicles in all categories other than M1 and N1 tested in multiple gears: the highest intermediate result from the gear ranges tested.
d. For vehicles tested at multiple speeds in all categories: the highest intermediate result.

6.4 Conditions of the Vehicles—Measurements shall be made on vehicles unladen (that is - at curb mass) plus the driver and instrumentation, and except for the case of nonseparable vehicles, without trailer or semitrailer.

The vehicle shall be equipped with components that are representative of the intended production unit including engine, driveline, and noise control systems.

The tires used for the test shall be selected by the vehicle manufacturer. They shall correspond to one of the tire sizes designated for the vehicle by the vehicle manufacturer and shall be inflated to the pressure(s) recommended by the manufacturer for the vehicle in its unladen (curb mass) condition. In the case of M1 to N3 vehicles, some European countries allow the use of tires with a tread depth to as low as 1.6 mm, on any part of the tread.

The powertrain and exhaust system temperatures shall be within the normal operating range throughout each test run.

NOTE—Usually, a vehicle brought to its normal engine coolant temperature through moderate driving conditions is adequately conditioned for testing.

6.5 Operating Conditions

6.5.1 GENERAL CONDITIONS—The vehicle shall approach line AA with the path of its centerline following as closely as possible the centerline CC as specified in 6.5.2.1 to 6.5.2.3 as appropriate.

When the front of the vehicle reaches line AA, within ±1.5 m, the throttle shall, as rapidly as possible, be opened as fully as will ensure maximum acceleration without operating kickdown (if any), and held until the rear of the vehicle reaches line BB; the throttle shall then be closed as rapidly as possible.

Any trailer which is not readily separable from the towing vehicles shall be ignored when considering the crossing of line BB.

If the vehicle is fitted with more than two-wheel drive, it shall be tested in the drive which is intended for normal road use.

If the vehicle incorporates equipment which is not normally in operation on the road, such as a concrete mixer, a compressor, etc., this equipment shall not be in operation during the test.

NOTE—It is recommended that supplementary measurements be made with the equipment operating.

6.5.2 SPECIAL CONDITIONS

6.5.2.1 Vehicles Without Transmission Range Selection—The vehicle shall approach line AA at a uniform vehicle speed corresponding to one of the following:

a. 50 km/h, or
b. An engine rotational speed equal to 3/4 of the speed, n, which is the rated engine speed, or
c. 3/4 of the engine maximum rotational speed allowed by the governor at full load conditions of the engine,

whichever is the lowest.

6.5.2.2 Manual Transmission Vehicle

a. Approach Speed—The vehicle shall approach the line AA' at a steady vehicle speed corresponding to the lower of the following speed with a tolerance ±1 km/h, except where the controlling factor is engine speed the tolerance shall be the larger of ±2% or 50 rpm:

   1. 50 km/h;
   2. The vehicle speed corresponding to an engine speed equal to three-quarters of the rated speed S in the case of vehicles of category M1, and in the case of vehicles of the other categories having an engine power not greater than 225 kW;
   3. The engine speed corresponding to an engine speed equal to half the rated engine speed S in the case of vehicles not belonging to category M1 and having an engine power greater than 225 kW.

b. Choice of Gear Ratios for M1 and N1—Vehicles in categories M1 and N1 equipped with a manually operated gearbox having not more than four forward gear ratios shall be tested in second gear.

   Vehicles in these categories equipped with a manually operated gearbox having more than four forward gear ratios shall be tested in second and third gears successively. Only overall gear ratios intended for normal road use are considered. The final reported value is that determined in 6.3.

If during the test in second gear, the engine speed exceeds the rated engine speed S, before the rear of the vehicle reaches the line BB, the test shall be repeated with the approach engine speed reduced by steps of 5% of S until the engine speed attained no longer exceeds S. If during the test in second gear, the approach engine speed has been reduced to the idle speed, and the engine attains the rated engine speed S before the rear of the vehicle reaches the line BB, then the test shall be performed only in third gear and the relevant measurement reported as in 7.5.

However, vehicles in category M1 having more than four forward gears and equipped with an engine developing a maximum power greater than 140 kW, and whose permissible maximum-power/ maximum-mass ratio exceeds 75 kW/ (1 metric ton) 1.2 ton, or 62.5 kW/ ton may be tested in third gear only, provided that the vehicle speed change during the acceleration is greater than 11 km/h over a distance of 20 m plus the vehicle length.

c. Choice of Gear Ratios in Categories other than M1, N1—Vehicles other than those in categories M1 and N1 in which the total number of forward gear ranges is x (including the ranges obtained by combining the transmission ratios and the gear ratios added by means of an auxiliary transmission or multiple ratio drive axle) shall be tested, sequentially, using the range equal to or higher than x/n, where n=2 for vehicle having a rated engine power not greater than 225 kW and n=3 for vehicles having a rated engine power greater than 225 kW.

The initial test will be carried out using the range which is gear (x/n) or the next higher gear range if (x/n) in not an integer. The testing shall continue from the gear (x/n) to the next higher gear.

Shifting up gear ranges from (x/n) shall be terminating when in the gear X in which the rated engine speed is reached just before the rear of the vehicle has passed the line BB'.

Sample Calculation for Testing—A vehicle has an engine with a power rating of 230 kW and thedrivetrain has 16 forward ranges available consisting of a primary transmission with 8 ratios and an auxiliary transmission with 2 ratios. The 230 kW engine has a divisor of 3, then calculation is (x/n) = (8 x 2)/3 = 16/3 = 5–1/3. The initial test gear range is 6th (includes the ratios from both the main transmission and auxiliary which is 6th out of the 16 total gear ranges), with the next gear range is 7th up to range X.

In the case of vehicles having different overall gear ratios (including a different number of gear ranges), the representativity of the type by the test vehicle is determined as follows:

1. If the highest sound pressure level is obtained between the range x/n and range X, the vehicle selected is deemed representative of its type for those vehicles which include the same gear ratios in the same ranges.
2. If the highest sound pressure level is obtained at range x/n, the vehicle selected is deemed representative of its type only for those vehicles which have a lower overall gear ratio at range x/n.
3. If the highest sound pressure level is obtained at range X, the vehicle selected is deemed representative of its type only for those vehicles which have a higher overall gear ratio than the gear ratio at range X.

However the vehicle, under test, is deemed representative of its type also, if at the applicant's request, the tests are extended over more ratios and the highest sound pressure level is obtained at a ratio that is between the extreme ratios tested.

6.5.2.3 *Automatic Transmission Vehicle*—Two cases may occur:

a. Vehicles without a manual selector shall be tested at various uniform approach speeds of 30, 40, and 50 km/h or at 3/4 of the maximum vehicle speed specified by the manufacturer if this value is lower. The condition yielding the highest sound pressure level , as determined in 6.3, shall be reported.

b.1. Automatic Transmission Vehicles Categories M and N—If a vehicle is equipped with an automatic transmission with a manual selector, conduct the test with the selector in the position recommended by the manufacturer for normal driving.

The vehicle shall approach the line AA' at a steady speed corresponding to the lower of the following speeds with a tolerance ±1 km/h; in cases where the controlling factor is engine speed, the tolerance shall be the larger of ±2% or ±50 rpm:

1. 50 km/h;
2. The vehicle speed corresponding to 3/4 of the rated engine speed, S, in the case of vehicles of category M1, and in the case of vehicles of the other categories having an engine power not greater than 225 kW;
3. The speed corresponding to half the rated engine speed S in the case of vehicles not belonging to category M1 and having an engine power greater than 225 kW.

b.2. Prevention of Downshift—Some vehicles equipped with an automatic transmission (two or more discrete ratios) may downshift to a gear ratio not normally used in urban driving, as defined by the manufacturer. A gear ratio not used for urban driving includes a gear ratio intended for slow movement, parking or braking. In these cases, the operator may select any of the following modifications:

1. Increase the vehicle speed v of the vehicle to a maximum of 60 km/h in order to avoid such a downshift.

2. Maintain the vehicle speed v at 50 km/h and limit the fuel supply to the engine to 95% of the supply necessary for full load[1]. This condition is considered to be satisfied when:

   a. In the case of a spark-ignition engine, the angle of the throttle opening is 90% of the full angle.
   b. In the case of a compression-ignition engine, the fuel supply to the injection pump is limited to 90% of its maximum supply.

3. Establish and use an electronic control that will prevent a downshift to gears lower than those used in normal urban driving as defined by the manufacturer.

   In all cases, the special selector's positions for slow movements, parking, or braking shall be excluded.

   If the vehicle is fitted with an auxiliary manual transmission or multi-gear axle, the position used for normal urban driving shall be used.

7. General Comments

7.1 It is recommended that persons technically trained and experienced in current sound measurement techniques select the test instrumentation and conduct the tests.

1. This condition shall be satisfied in the case of a spark-ignition engine when the angle of the butterfly valve is 90% of full travel, and in the case of a compression-ignition engine when the movement of the feed-rack of the injection pump is limited to 90% of its stroke.

7.2 When making sound level measurements, not more than one person other than the observer reading the meter shall be within 15 m of the vehicle or microphone, and that person shall be directly behind the observer reading the meter, on a line through the microphone and the observer.

7.3 Proper use 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 to be considered are:

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

7.3.2 The effects of ambient weather conditions on the performance of all instruments (for example, temperature, relative humidity, and barometric pressure).

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

7.3.4 Proper acoustical calibration procedures, to include the influence of extension cables, etc. Field calibration shall be made immediately before and after each test sequence. Internal calibration is acceptable for field use, provided that external calibration using a sound level meter calibrator meeting the requirements of ANSI S1.40-1984 is accomplished immediately before and after field use.

7.4 Many tachometers in common use have an appreciable time lag in response during vehicle acceleration. The use of such a tachometer without suitable correction could result in the attainment of higher than intended engine speed and possible effects on measured sound levels.

7.5 Vehicles used for tests shall not be operated in a manner such that the break-in procedure specified by the manufacturer is violated.

7.6 It should be recognized that variations in measured sound levels may occur due to variations in test site, ambient weather differences (temperature, wind, and their gradients), test equipment differences, and inherent differences between nominally identical vehicles.

7.7 Vehicles with diesel engines should be tested using Number 1D or Number 2D diesel fuel possessing a cetane rating from 42 to 50 inclusive (recommended by the manufacturer for use by the purchaser.)

7.8 Vehicles with gasoline engines shall use the grade of gasoline recommended by the manufacturer for use by the purchaser.

7.9 **Measurement Uncertainty—**Measurements made in conformity with this document results in levels that are influences by climatic conditions. The climatic conditions can affect the performance of the vehicle powertrain, modify the level from the tires, and disturb the propagation path of the sound. In addition, the use of the asphalt test surface specified in ISO 10844 has reduced, but not eliminated, the variations traditionally encountered from different site. Tests of a vehicle at the same site, in similar climatic conditions will result in sound levels that are within ±1 dB. However, testing over the entire range of temperature and wind conditions allowed in this document may result in greater variation. This document encourages the measurement and reporting of additional environmental conditions, to develop a better understanding of the effect of these factors on the measurement. The test temperature range and the wind speed limit as well as the tolerance on vehicle operation provides some reduction of the variations. See appendix A.

8. Test Report

8.1 In the event preparation of a formal test report is required, the report shall contain the following information:

8.1.1 Reference to this document;

8.1.2 Details of the test site, site orientation, the testing surface conditions and weather conditions including wind speed and air temperature. Wind direction, barometric pressure, humidity and track surface temperature are optional measurements and should also be recorded if available date, and test personnel;

8.1.3 The measurement equipment (including windscreen);

8.1.4 The measured A-weighted sound pressure level typical of the background noise;

8.1.5 The identification of the vehicle, its engine, its transmission system including available transmission ratios, size and type of tires, tire pressure, tire tread depth, test mass, and vehicle length;

8.1.6 The transmission gears or gear ratios used during the test;

8.1.7 The vehicle and engine speeds at the beginning of the period of acceleration, and the location of the beginning of the acceleration;

8.1.8 The vehicle speed and engine speed at the end of the acceleration;

8.1.9 The auxiliary equipment, where appropriate, and its operating conditions; and

8.1.10 The A-weighted sound pressure level values measured, from all valid runs, listed according to the side of the vehicle and the direction of the vehicle movement on the test site.

9. Notes

9.1 **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.

PREPARED BY THE SAE VEHICLE SOUND LEVEL FORUM COMMITTEE AND THE SAE LIGHT VEHICLE EXTERIOR SOUND LEVEL STANDARDS COMMITTEE

APPENDIX A

RATIONALE

***Preface*—**SAE J1470 has been changed to recognize the updates that have occurred in the ISO 362 procedure. While the procedure conforms to the test cycles used in the majority of the European countries as well as the United States State and Local requirements, it is important that the actual regulations of a specific country be reviewed to insure that this procedure meets the specific country law.

This procedure compliments other SAE procedures that measure the vehicle under maximum operating mode compared to this more typical urban driving cycle which utilizes intermediate gear ratios. The procedure does not include motorcycles which are covered by other SAE procedures.

1. **Scope**—This section has been updated to highlight the importance of the procedure being used in the manufacturing and official testing facilities but acknowledges the limitations of the use of a local street or large asphalt areas such as routine parking lot construction facilities. This section also indicates that the motorcycle procedure developed by the SAE Motorcycle committee is more representative of actual use than the cycle used in the ISO procedure. Therefore, the ISO section for motorcycles is not included in this SAE procedure.

2. **Applicable Documents**—This section has been expanded and updated to include the recent data contained in engineering reports and test procedures that are representative of current technology for vehicle passby testing. Section 3.1 adds reference to a SAE report for a cooperative research project comparing the traditional SAE and ISO surface. The ISO surface tends to de-emphasize the tire/road noise during the acceleration compared to the sealed SAE surface. 2.1.5 adds the ISO reference for the test surface construction and performance measurements.

   2.1.6—Adds reference to the common market regulation which is the pattern for some of the vehicle gear selector criteria.

3. **Definitions**—This section contains the modified definitions that clarify the terminology specific to the procedure that were not used in previous procedures or have a specific meaning to the procedure.

   3.1—Modified the automatic downshift definition introducing the idea for allowing the vehicle manufacturer to develop data verifying the appropriate urban gear for the powertrain being tested.

   3.4—The intermediate result term introduced to identify the value determined from one or more series of runs to be combined for the reported value. The procedure requires multiple runs in some cases prior to determining a reported value.

   3.5—Defines the mass of the vehicle configuration that is being tested, and notes the difference between U.S. and British terms for mass.

   3.6—Clarifies the engine speed used to determine the approach and conditions of the test run. For use in U.S. jurisdiction, it is the same as SAE net rated hp engine speed. In addition there is a note regarding the difference between “net rated RPM” and “governed engine speed”.

   3.7—Defines the vehicle categories at function use, capacity, and mass. These classifications determine the test protocol to be used in the measurements.

4. Instrumentation for Acoustical Measurements—This section has been modified to include the new requirements for verifying the conformance of the acoustic equipment. The intent and the effect is to improve the calibration practice that identify a potential problem in the measurement equipment. It also includes the recommended sampling rate for equipment that used a digital processing technique. This section also adds the requirements for the accuracy of the meteorological equipment that reports the variables that have been shown to effect the sound measurement.

4.1—Adds the requirement for use of a wind screen during the measurement and limits the allowable influence of the wind screen on the measurement. Engineering data supports the need for wind protection even at the limited wind speed allowed. Use of the windscreen helps improve the repeatability of the measurements.

This section also requires a verification of the acoustical test equipment. The requirement allows for calibration by a qualified laboratory. The requirement forces a reference to a traceable standard. It is not so rigid as to force a government approval but allows any laboratory meeting the quality and standards tractability to perform the verification. This section further specifies the need for a digital sampling rate, fast enough to maintain the accuracy of the instrument system.

4.2—Instrument specifications defines the performance expected over the range of measurements. New analog, digital, and hybrid instruments have improved measurement techniques. The devices may have extended ranges that exceed the range typically used and the single reference to full scale or a (%) of full scale may oversimplify the measurement accuracy. The user must be knowledgeable of the instruments used and verify the performance in the range used.

5.1 Test Site—The test surface in all SAE procedures has been specified as a highly reflective uniform asphalt plane. The ISO committee has developed a new surface specification that reduces some of the variation that has occurred in the test sites used. The ISO 10844 construction material and installation technique as well as the performance criteria of macrotexture, residual voids, and absorption characteristics have improved on the site uniformity. However, the SAE surface specification with the application of a surface sealer provides a similar uniformity in the test site surface. The surface texture for the ISO specification has resulted in a reduction in the tire road noise component of the vehicle noise. As a result, the ISO surface is better for measurement of vehicles at lower regulated levels where the objective is to measure powertrain noise and de-emphasize the tire/road noise component.

5.1.c—This paragraph notes the need for a special surface construction when applying this procedure for vehicles exported to some countries. Because of the surface characteristics, the tire/road noise is often lower on this surface than the SAE surface. The performance criteria of the ISO 10844 minimizes the test surface absorption. The ISO surface with an absorption coefficient of less than 0.1 can be characterized as comparable to the SAE sealed surface which also has an absorption coefficient of approximately 0.04. The correlation of the surfaces was shown in SAE Noise and Vibration Conference 951361.

5.1.d—This paragraph requires the surface to be constructed in a uniform plane. A measurement area with surface flatness deviations tends to increase run-to-run variations.

5.2—The recommendation for testing in a limited temperate range is the result of years of data collection where individual product lines are significantly influenced by temperature changes. The lower limit allows fairly nonrestricted testing but recognizes the vehicle performance and instrument changes at the lower temperatures. Again, this procedure does not prevent measurement outside this range but makes test personnel aware of the need to consider temperature in the measurement variability. The recommendation for measuring the other atmospheric quantities again raises the need to be aware of the typical measurement environment. It does not prevent measuring sound level in any conditions.