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INTERNATIONAL
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SURFACE VEHICLE RECOMMENDED PRACTICE

SAE J57

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Sound Level Of Highway Truck Tires

Foreword—This SAE Recommended Practice establishes a test procedure for measuring the sound level produced by tires intended primarily for highway use on motor trucks, truck tractors, trailers and semitrailers, and buses.

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1. Scope

1.1 This procedure provides for the measurement of the sound generated by a test tire, mounted on a single-axle trailer, operated at multiple speeds.

1.2 The procedure describes test practices for both United States and International practices.

1.3 Specifications for the instrumentation, the test site, and the operation of the test apparatus are set forth to minimize the effects of extraneous sound sources and to define the basis of reported sound levels.

2. References

2.1 Applicable Publications—The following publications pertain to noise measurement and tire noise. The references not directly cited in the text are suggested background information for individuals performing tire noise testing.

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

SAE J184—Qualifying a Sound Data Acquisition System

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

ANSI S1.4 & S1.4A—Specification for Sound Level Meters

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

ISO 10844—Acoustics—Test surface for road vehicle noise measurement

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

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

SAE Publication SP-373—Truck Tire Noise
SAE Paper 740607—Effect of Road Surface and Bed Clearance on Truck Tire Noise, Thurman, G.R
SAE Paper 740606—Regulatory Implications of Truck Tire Noise Studies, Close, W.H.
SAE Paper 850969—Vehicle Sound Measurement—20 Years of Testing, Howell, T.M. and Schumacher, R.F.
SAE Paper 800282—Relative Influence of Pavement Texture and Tire Type on Pavement/Tire Noise, Osman, M.M. and May, D.N.
SAE P-70—Proceedings from the SAE Highway Noise Symposium, Nov., 1976

2.2.2 ACOUSTICAL SOCIETY OF AMERICA PUBLICATIONS—Available from Acoustical Society of America, 500 Sunnyside Boulevard, Woodbury, NY 11797-2999.

J. Acoust. Soc. Am., 76(4), October 1984, pp. 1150–1160, “Effects of Environmental Variables on Truck Noise Emission and Noise Propagation to Test Microphones,” Hemdal, J.F., Baker, R.N., and Saha, P.
J. Acoust. Soc. Am., Vol. 58, No. 1, July 1975, pp. 39–50, “Tire-Road Interaction Noise,” Leasure, W.A. and Bender, E.K.

2.2.3 DOT PUBLICATIONS—Available from the United States Department of Transportation.

DOT HS-AS-60031, January 1979, US DOT, "Effects of Load, Inflation Pressure, and Tire Deflection on Truck Tire Noise Levels," Kilmer, R.D., Codoff, M.A., Mathews, D.E., and Shoemaker, C.O.
DOT Report No. DOT-TST-76-4, August 1975, "Automobile Tire Noise: Results of a Pilot Study and Review of the Open Literature," Leasure, W.A., Mathews, D.E., and Codoff, M.A.

2.2.4 TIRE AND RIM ASSOCIATION PUBLICATION—Available from The Tire and Rim Association, Inc., 175 Montrose West Ave., Suite 150, Copley, OH 44321.

The Tire and Rim Association Yearbook, latest edition

3. Instrumentation

3.1 The following instrumentation shall be used for the measurements as required:

a. A sound level meter which satisfies the Type 1 or S1A requirements of American National Standard Specification for Sound Level Meters, S1.4 or S1.4A (latest revision) or its ISO equivalent.

1. As an alternative to making direct measurements using a sound level meter, a microphone may be used with a magnetic or digital tape recorder and/or a graphic level recorder or other indicating instrument, providing the system meets the requirements of SAE J184 (latest revision).

b. An acoustical calibrator, having an accuracy of ±0.5 dB, for establishing the calibration of the sound level meter and associated instrumentation.
c. An anemometer having an accuracy of ±10% at 18 km/h (11 mph).

4. Test Site

4.1 The test site shall be located on a flat area which is free of reflecting surfaces (other than the ground), such as parked vehicles, trees, or buildings within 30 m (100 ft) of the measurement area.

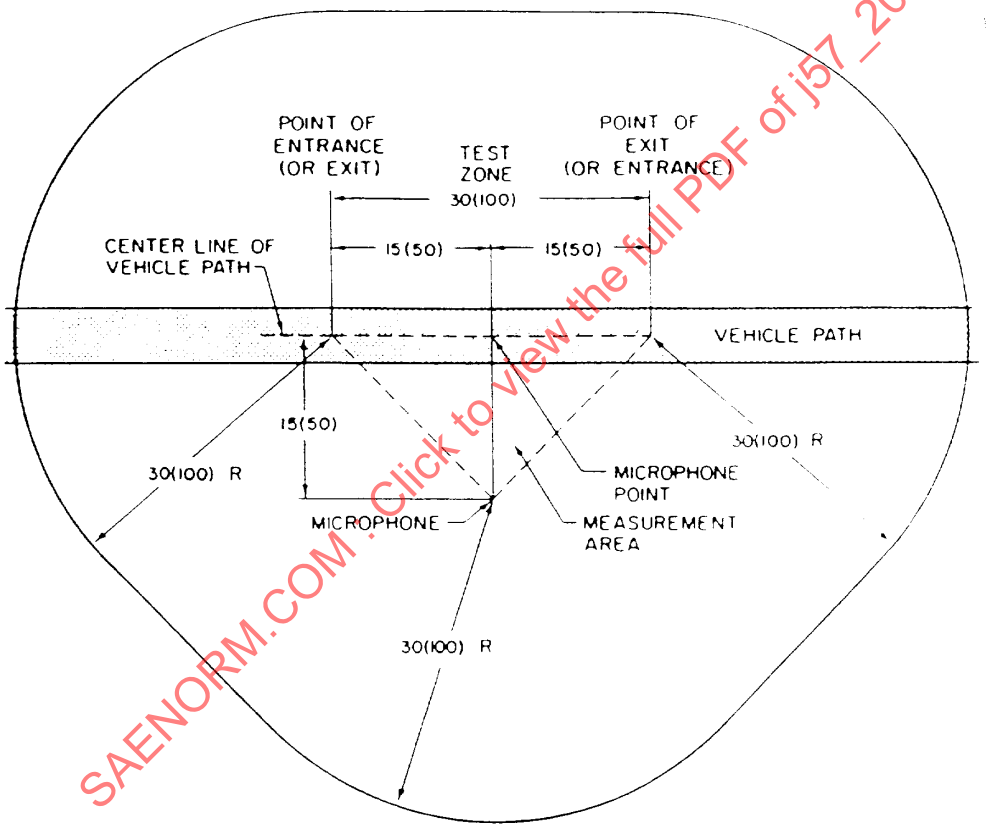
4.2 The vehicle path, within the Test Zone, shall meet the requirements of ISO 10844. The vehicle path shall be dry and free of extraneous material.

4.3 The microphone shall be located at a height of 1.2 m (4 ft) above the ground plane. The normal to the vehicle path from the microphone shall establish the microphone point on the vehicle path. The distance from the microphone to the microphone point shall be as follows:

a. 15 m (50 ft) for testing representative of United States practices. See Table 1 and Figure 1.
b. 7.5 m (25 ft) for testing representative of International practices. See Table 2 and Figure 2.

TABLE 1—CRITICAL DIMENSIONS FOR UNITED STATES PRACTICES (J57 TEST A)

	SI Units	U.S. Customary Units
Distance Between Centerline of Veh. Path and Microphone	15 m	50 ft
Microphone Height	1.2 m	4 ft
Test Zone Length	30 m	100 ft
Low Speed Pass	56 km/h ± 1 km/h	35 mph ± 0.6 mph
High Speed Pass	80 km/h ± 1 km/h	50 mph ± 0.6 mph

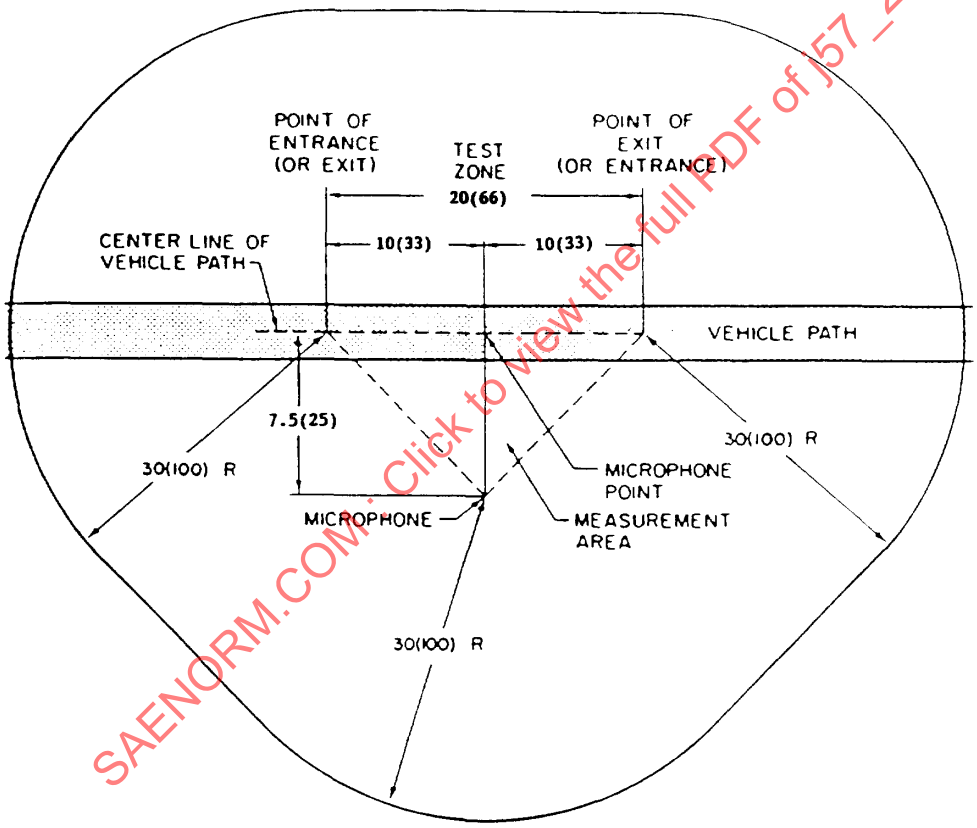


NOTE—Dimensions are m (ft)

FIGURE 1—TEST SITE (U.S. PRACTICE)
(VEHICLE MAY BE RUN IN EITHER DIRECTION)

TABLE 2—CRITICAL DIMENSIONS FOR INTERNATIONAL PRACTICES (J57 TEST B)

	SI Units	U.S. Customary Units
Distance Between Centerline of Veh. Path and Microphone	7.5 m	25 ft
Microphone Height	1.2 m	4 ft
Test Zone Length	20 m	66 ft
Low Speed Pass	60 km/h ± 1 km/h	37 mph ± 0.6 mph
High Speed Pass	80 km/h ± 1 km/h	50 mph ± 0.6 mph



NOTE—Dimensions are m (ft)

FIGURE 2—TEST SITE (INTERNATIONAL PRACTICE (VEHICLE MAY BE RUN IN EITHER DIRECTION)

4.4 The measurement area is the triangular area formed by the point of entrance into the test zone, point of exit from the test zone, and the microphone. The test zone is established as follows:

a. The test zone extends 15 m (50 ft) on either side of the microphone point along the vehicle path for testing representative of United States practices. See Table 1 and Figure 1.
b. The test zone extends 10 m (33 ft) on either side of the microphone point along the vehicle path for testing representative of International practices. See Table 2 and Figure 2.

4.5 The measurement area (excluding vehicle path) should be surfaced with concrete, asphalt, or similar hard material, having a Coefficient of Absorption not exceeding 0.10 measured as specified in ISO 10844, and in any event, should be free of snow, grass, soil, ashes, or other sound-absorbing materials.

4.6 The ambient sound level (including wind effects) at the test site shall be at least 10 dB below the level of the subject tires operated in accordance with the test procedure.

4.7 The wind speed in the measurement area shall be less than 18 km/h (11 mph).

4.8 The ambient air temperature of the test location shall be between 10 and 30 °C (50 and 86 °F) throughout the test.

4.9 Test surface temperature shall be between 5 and 40 °C (41 and 104 °F) throughout the test.

4.9.1 The surface reference temperature shall be 20 °C (68 °F). The reported sound levels shall be corrected to this temperature by means of the procedure set forth in 7.5.

5. Test Apparatus

5.1 The test apparatus shall consist of two parts:

a. Tow Vehicle

1. The rolling noise of the towing vehicle can be minimized by appropriate measures (low-noise tires, shielding, aerodynamic skirting, etc.) to a point at which the sound level for the tow vehicle alone is at least 3 dB(A) lower than for the tow vehicle-trailer combination with the subject tires.

b. Trailer

1. The trailer shall be a single-axle frame trailer with drawbar and a facility for varying wheel load. Superstructures or paneling are to be avoided in order to minimize vehicle-specific influences.
2. An axle assembly consisting of a single axle with one test tire on each end shall be rigidly suspended from the trailer.

5.2 The test apparatus shall be operated in a coasting mode with the tow vehicle power turned off.

6. Tires

6.1 Before measurements are started, a tire break-in period of at least 80 km (50 miles) at typical highway speeds is required.

6.2 Tires should be at normal operating temperature during the test.

6.3 Tires shall be singly mounted on the test trailer.

6.4 The tires shall be inflated to 85% of the pressure corresponding to the maximum single tire load that is molded on the sidewall, and loaded to 70% of the maximum single tire load that is molded on the sidewall.

7. Procedure

7.1 The tow vehicle shall be used to attain sufficient speed prior to entering the test zone, such that, when the tow vehicle engine is switched off and the vehicle and trailer are coasting into the test zone, the trailer speed at the microphone point will be as listed in 7.1.1.

7.1.1 The trailer speed at the microphone point shall be:

a. Refer to Table 1 for testing representative of United States practices.
b. Refer to Table 2 for testing representative of International practices.

7.2 The sound level meter shall be set for fast dynamic response and the A-weighting network.

7.3 There shall be at least five measurements for each test speed. The observer shall record the highest level attained during each pass. Measurement shall continue until five levels for each speed are recorded which are within ±0.5 dB(A) of their arithmetic average. This arithmetic average is to be used for the temperature correction calculations in 7.5.

7.3.1 Alternatively, each pass may be recorded on magnetic or digital tape, or any other generally accepted recording device, and subsequently analyzed with a sound level meter, graphic level recorder, or acoustic frequency analyzer. The reported data from this analysis must comply with 7.3 and the environmental conditions required to qualify the test results shall be recorded.

7.4 The surface temperature of the vehicle path shall be measured immediately after the completion of the test passes which compose the arithmetic average of 7.3.

7.5 The arithmetic average of the measured sound pressure levels will be corrected to the surface reference temperature specified in 4.9.1. Two levels shall be measured, one at a surface temperature within the range specified in 4.9 and above the reference temperature, and a second at a surface temperature within the range and below the reference temperature. As demonstrated in Figure 3, the predicted level at the reference temperature is obtained through linear interpolation.

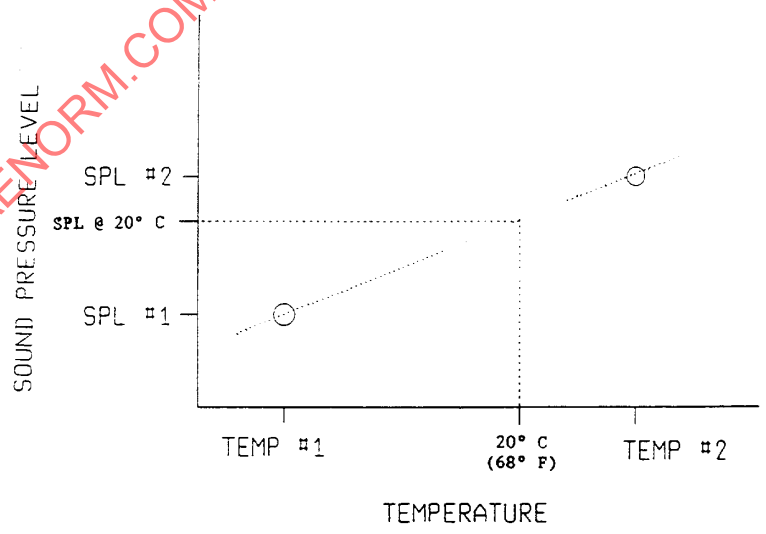


FIGURE 3—TEMPERATURE ADJUSTMENT EXAMPLE

7.5.1 An alternative correction method may be used if ambient conditions preclude obtaining measured levels at surface temperatures both above and below the reference temperature. In this case, a least-squares linear regression line may be calculated for correction of levels to the surface reference temperature. To insure adequate separation of the data points, the regression line shall be calculated based on at least three surface temperatures differing from one another by at least 2 °C (3.6 °F) and covering a range of at least 5 °C (9 °F). The calculated slope and intercept of the regression line shall be reported with the sound pressure level corrected to the surface reference temperature.

7.6 Determination of the tow vehicle noise must be made prior to reporting test tire sound levels. The tow vehicle sound level must be corrected to the surface reference temperature by the method outlined in 7.5.

7.7 The subject tires' sound levels reported are the difference between the sound pressure level of the tow vehicle-trailer combination and the sound pressure level of the tow vehicle alone. This is represented by Equation 1:

$$L_{tire} = 10 \log_{10}[10^{(Ltp/10)} - 10^{(Lt^1/10)}] \quad \text{(Eq. 1)}$$

where:

L_{tire} = temperature corrected sound level of the subject tire (this is the level reported)
Ltp = temperature corrected sound level of the test pass (tow vehicle and trailer assembly)
Lt' = temperature corrected sound level of the tow vehicle without trailer, corrected for drawbar length as shown in Equation 2:

$$Lt^1 = Lt - 10 \log_{10}[(d^2 + Md^2)/Md^2] \quad \text{(Eq. 2)}$$

where:

Lt = temperature corrected sound level of the tow vehicle without trailer
d = distance measured from rear axle of tow vehicle to axle of trailer, in meters
Md = microphone distance, either 7.5 or 15 m

7.8 The reporting of the sound level shall include the data as set out in the form shown in Appendix A.

7.8.1 Test results representative of United States practices shall be reported in the “J57 Test A” data fields. Test results representative of International practices shall be reported in the “J57 Test B” data fields.

8. Notes

8.1 Key Words—Microphone, noise, passer-by, road, sound, test, tire, truck, vehicle.

PREPARED BY THE MOTOR VEHICLE COUNCIL SOUND LEVEL COMMITTEE