TEST PROCEDURES

SAE Recommended Practices: Please see the section after page 42 printed by the Society of Automotive Engineers.

SAE J-336	(6-68)	Sound Level for Truck Cab Interior
SAE J-366a	(6-71)	Exterior Sound Levels for Heavy Trucks and Busses
SAE J-952b	(1-69)	Sound Levels for Engine Powered Equipment
SAE J-919a	(4-71)	Sound Level Measurements at the Operator Station for Agricultural and Construction Equipment

Idle-Maximum Governed Speed-Idle Noise Test: This is a stationary vehicle test which evaluates the engine related noises. It is called an Idle-Maximum Governed Speed-Idle test (I-M-I). The test consists of a rapid acceleration of the engine at wide open or maximum throttle (WOT) conditions from Idle speed up to the Maximum Governed Speed and then a rapid decelerating back to Idle speed at the minimum throttle conditions. Rapid application of the throttle to the maximum fuel and then to minimum fuel condition is required. The transmission should be in neutral condition.

The noise generated under this I-M-I test condition appears to be representative of the maximum passby or spectator highway truck noise as measured by SAE J-366 test methods at 50 feet for less than 35 mph. The cab or operator noise level in the cab generated by this I-M-I test condition also appears to be representative of the maximum interior or operator noise as measured by the SAE J-336 test method. The instrumentation and procedures other than the mode of operation are the same as prescribed in the referenced SAE test procedures.

The assumption for using this I-M-I testing is that at the low vehicle speeds (less than 35 mph) the tire and other vehicle component noise is less than the engine related noise sources, therefore a measurement of the engine noise is representative of the vehicle noise. During this test the maximum engine noise is generated during the acceleration of the engine against its own inertia. The I-M-I results in more noise than a constant speed test at maximum governed speed because of the greater fuel inputs. Constant speed tests at maximum governed speed will not produce maximum exhaust noise.

The I-M-I test is a simple test of a stationary vehicle which could be used for quick evaluation or enforcement purposes. The test site does not have to be very large and may not be as restrictive due to a greater tolerance of noise level generally allowed for enforcement type tests, i.e. 2dB(A).

This I-M-I test procedure is being evaluated by the SAE Vehicle Sound Level Committe and the Department of Transportation.

APPLICATION INFORMATION SHEET

TEST NO._____

APPLICATION:_____

Make_____ Year_____ Mileage or Hours_____

Model_____ Serial No._____ Rating_____

Type_____

ENGINE: Make _____ Model No._____ Serial No._____

Cycle_____ Rated BHP_____ at_____ RPM Governor RPM_____

C.I.D._____ Per Cylinder C.I.D._____ Total Bore and Stroke _____

Injector _____ Injector Timing_____ Cam Timing_____

Intercooled_____ Turbocharger_____ Model No._____

Engine Mounts: Front_____

Rear_____

EXHAUST SYSTEM: Mufflers: Make_____ Model No._____

Single: Right_____ Left_____ Dual_____ Horizontal_____ Vertical_____

Back Pressure: Right_____ Left_____ In. Hg at _____ RPM _____ Load

Inlet Dia._____ Outlet Dia._____ Dimensions_____

Exhaust Pipe Length_____ Ft. Tail Pipe Length_____ Ft. Location_____

Resonator: Make_____ Model No._____

AIR INTAKE SYSTEM: Intake Restriction_____ In. H_2O at_____ RPM_____ Load

Air Cleaner: Paper_____ Oil_____ Make_____ Model No._____

Location_____ Inlet Dia._____ In. Outlet Dia._____ In. Dim._____

Location of Cold Air Inlet_____

Silencer: Make_____ Model_____

FAN: Diameter_____ In. No. of Blades_____ Projected Width_____

Type: Suction_____ Blower_____ Blade Spacing: Equal_____ Unequal_____

Mounting Location_____ Center Distance_____ In.

Crankshaft Pulley Dia._____ Fan Pulley Dia._____ Fan/Eng. Ratio_____

Shroud Dia._____ Tip Clearance: Min._____ Max._____

ENCLOSURE:_____

_____

_____

E.O._____

Date_____ D.S._____

Observer_____

E.O._____

NOISE DATA SHEET

Date_____ D.S._____

Observer_____

APPLICATION_____

ENGINE: Model_____ Serial No._____ Injectors_____ RPM_____

Load_____ Temp._____ °F Ambient_____ dB(A) Wind_____ RPM

Test Site:_____ Tape No._____ Footage_____

Test No. & Description:_____

MODIFICATIONS:									
1. Exhaust pipe				1.			1.		
2. Muffler				2.			2.		
3. Tail pipe				3.			3.		
4. Air inlet				4.			4.		
5. Fan				5.			5.		
6. Shutters				6.			6.		
7. Accessories				7.			7.		
8. Mounts				8.			8.		
9. Hoods and skirts				9.			9.		
10. Firewall				10.			10.		
11. Cab interior				11.			11.		
A. Exterior: Passby			No/Footage						
1. SAE J-366 (50 Ft.)	Accelerate	Right		1.			1.		
		Left							
	Decelerate	Right							
		Left							
2. ISO R-362 (25 Ft.)	Accelerate	Right		2.			2.		
		Left							
	Decelerate	Right							
		Left							
3. Driveby (50 Ft.)	MPH_____	Right		3.			3.		
		Left							
4. Coastby (50 Ft.)	MPH_____	Right		4.			4.		
		Left							
B. Exterior: Stationary			No/Footage						
1. SAE J-952 (50 Ft.)	RPM_____	Right		1.			1.		
	Load_____	Left							
		Front							
		Rear							
*2. ISO R-362A1 (25 Ft.)	RPM_____	Right		2.			2.		
	Load_____	Left							
		Front							
		Rear							
*3. Idle-Max-Idle	RPM_____	Right		3.			3.		
		Left							
4. Idle	RPM_____	Right		4.			4.		
		Left							
C. Interior:			No/Footage						
1. SAE J-336	(Accelerate)	Closed		1.			1.		
*2. SAE J-919	(Stationary)	Closed		2.			2.		
	RPM_____	Open							
*3. Idle-Max-Idle	RPM_____	Closed		3.			3.		
		Open							
4. Idle	RPM_____	Closed		4.			4.		
		Open							

*Attached Octave Analysis Data Sheet for Highest dB(A) Condition. (34)

NOISE DATA SUMMARY SHEET

APPLICATION: _____

ENGINE: Model _____ Serial No. _____ Injector _____ RPM _____

TEST SITE: _____

REMARKS: _____

TEST DESCRIPTION		EXTERIOR			INTERIOR		
		SAE J-366	SAE J-952	I-M-I	SAE J-336	SAE J-919	I-M-I
ORIGINAL OVERALL (R/L)							
ORIGINAL NOISE SOURCES							
Exhaust							
Air Intake							
Fan							
Engine Accessories							
Engine (Quiet)							
Appl. Equipment							
MODIFIED NOISE SOURCES							
Exhaust	Test No. 1						
	2						
	3						
	4						
Air Intake	Test No. 1						
	2						
	3						
	4						
Fan	Test No. 1						
	2						
	3						
	4						
Accessories	Test No. 1						
	2						
	3						
	4						
Engine	Test No. 1						
	2						
	3						
	4						
Application	Test No. 1						
	2						
	3						
	4						
MODIFIED OVERALL							

E.O. _____

Date _____ D.S. ____

Engineer _____

ENGINE NOISE DATA SHEET

APPLICATION:_____

ENGINE: Model_____ Serial No._____ Injectors_____ RPM_____

Load_____ Temp._____°F Ambient_____dB(A) Wind_____MPH

Test Site:_____ Test No. & Description_____

REMARKS:_____

Distance	Height	Speed	Position	Linear	dB(A)	Linear	dB(A)	Linear	dB(A)
1. 3 Ft.		Rated RPM_____	Right Left Front	1.		1.		1.	
2.		Peak Torque RPM_____	Right Left Front	2.		2.		2.	
3.		Maximum No Load RPM_____	Right Left Front	3.		3.		3.	
4.		Idle RPM_____	Right Left Front	4.		4.		4.	
1. 50 Ft.		Rated RPM_____	Right Left Front	1.		1.		1.	
2.		Peak Torque RPM_____	Right Left Front	2.		2.		2.	
3.		Maximum No Load RPM_____	Right Left Front	3.		3.		3.	
4.		Idle RPM_____	Right Left Front	4.		4.		4.	
1. 25 Ft.		Rated RPM_____	Right Left Front	1.		1.		1.	
2.		Peak Torque RPM_____	Right Left Front	2.		2.		2.	
3.		Maximum No Load RPM_____	Right Left Front	3.		3.		3.	
4.		Idle RPM_____ Front	Right Left Front	4.		4.		4.	

Attached Octave Analysis Data Sheet for Highest dB(A) Condition.

E.O._____

Date_____ D.S._____

Observer_____

SOUND LEVEL TEST REPORT FOR PORTABLE COMPRESSORS PER CAGI-PNEUROP CODE — REPORT FORM NO. 8.3.2

SUBJECT:

Model: _____ Manufacturer: _____ Serial: _____
Rated Speed & Capacity: _____
Description: _____
_____

TEST CONDITIONS:

Distance from Subject to Microphone: _____ Meters
Operating Speed as Tested: _____ Air Pressure Supplied: _____ Bars
Height of Microphone Above Reflecting Plane: _____ Meters
Reflecting Plane Composition: _____
Remarks: _____
_____

INSTRUMENTATION:

Microphone: _____ No. _____
Sound Level Meter: _____ No. _____
Octave Band Analyser: _____ No. _____
Calibrator: _____ No. _____
Other: _____ No. _____

DATA:

dB Ref. 2×10^{-5} N/m²		BACK-GROUND	IDLE CONDITION						FULL LOAD CONDITION					
			LOCATION *					AV.	LOCATION *					AV.
			1	2	3	4	5		1	2	3	4	5	
MID-BAND FREQ. H_z	dB A													
	63													
	125													
	250													
	500													
	1 k													
	2 k													
	4 k													
	8 k													

*Corrected for background sound. Readings having 3 dB corrections must be reported in brackets.
Only octave bands of interest per paragraph 6.3 need to be reported.

TESTED BY: _____ DATE: _____

REPORTED BY: _____ DATE: _____

OCTAVE BAND DATA SHEET

APPLICATION: _____

Make: _____ Model _____ Serial No. _____ Rating _____

Engine: Model _____ Serial No. _____ Injector _____

Microphone: Height _____ Distance _____ Position _____

Test Site: _____ AMB _____ dB(A) Wind _____ MPH Temp. _____ °F

Test Equipment: SLM Serial No. _____ Recorder Serial No. _____

Test Conditions: Speed _____ Load _____

_____

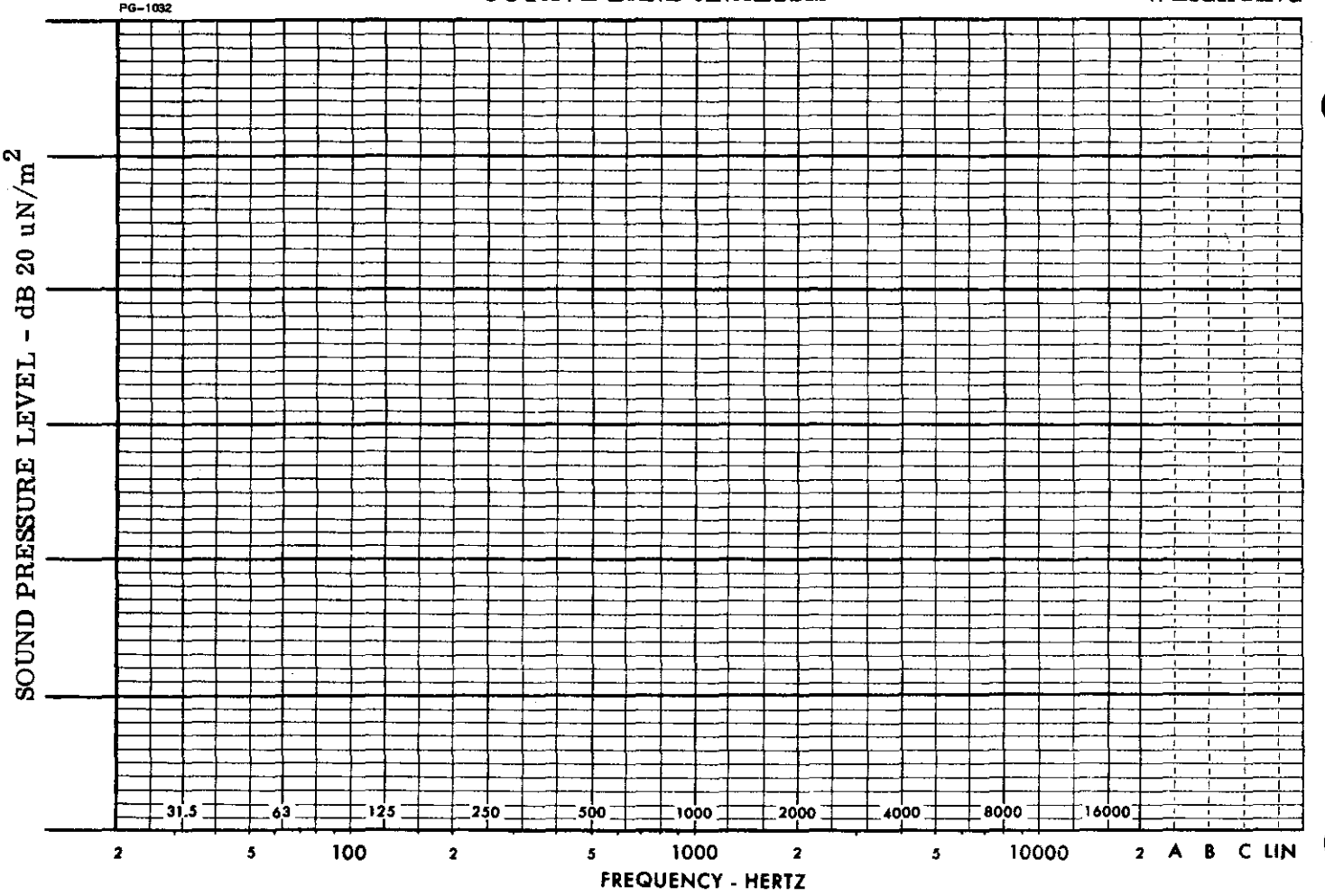
_____

Remarks: _____

_____

TEST NO. _____

OCTAVE BAND ANALYSIS WEIGHTING



Tape No. _____ Footage _____ E.O. _____

Engineer _____ Date _____ D.S. _____

PG-1966

ACOUSTICAL DATA SHEET

JOB NO. _____ DATE _____

REQUESTED BY _____ ANALYZED BY _____

SOURCE: TAPE NO. _____ OR _____

ANALYZER _____ LEVEL RECORDER _____

COMMENTS _____

25									
31.5									
40									
50									
63									
80									
100									
125									
160									
200									
250									
315									
400									
500									
630									
800									
1000									
1250									
1600									
2000									
2500									
3150									
4000									
5000									
6300									
8000									
10,000									
12,500									
16000									
20.000									
A									
B									
C									
LINEAR									

LEGISLATION, REGULATIONS, AND SPECIFICATIONS

Legislation:

Federal: Noise Control Act of 1972, Public Law 92-574, Oct. 27, 1972, Occupational Safety and Health Administration, Federal Register, Volume 36, Number 105, May 29, 1971.

States:	California	Year	1971	1973	1975	1978	1988
		Trucks	88*	86	83	80	70
	Colorado	Year	1971	1973			
		Trucks	88	86			
	Connecticut	Year	1972		1975		
		Truck	86		85		
	Minnesota	Year	1972	1973	1975		
		Truck	88	88	86		
	Nebraska	Year	1972	1973	1975	1980	
		Trucks	88	86	84	80	
	Nevada	Year	1972	1973			
		Trucks	88	86			
	Pennsylvania	Year		1973			
		Trucks		90			
Cities:	Boston	Year	1970	1973	1975	1980	
		Trucks	88	86	84	75	
		Const. & Industrial	88	-	-	80	
	Chicago	Year	1971	1973	1975	1980	
		Trucks	88	86	84	75	
		Year	1972	1973	1975	1980	
		Const. & Industrial	94	88	86	80	
	New York	Year		1973			
		Trucks		86			
	Salt Lake City	Year		1973	1974	1975	1988
		Trucks		86	-	-	-
		Const. & Industrial		94	88	86	80

*Acceleration passby at 50 feet with noise expressed in dB(A). The tests are similar to SAE Recommended Practices.

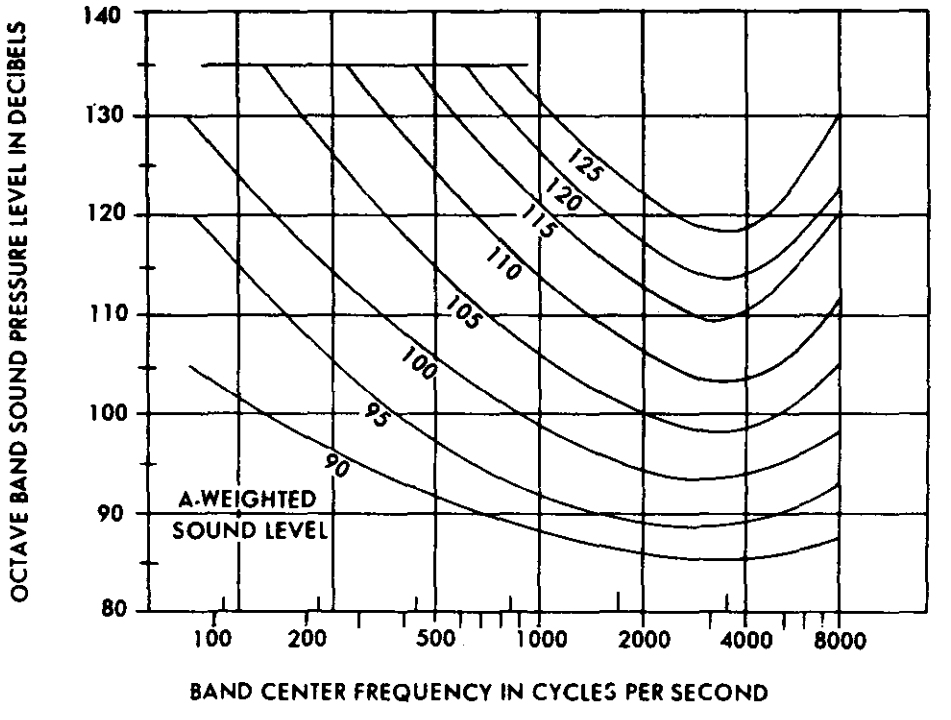
Legislation - Continued

Foreign:	Canada	Year	1973
		Trucks	88
	Common Market Countries	Year	1971
		Trucks	89**(≤200 bhp)
			91 (>200 bhp)

**Acceleration passby at 25 feet with noise expressed in dB(A). The tests are similar to ISO R362 test procedures.

*Walsh-Healey Act/Occupational Noise Exposure:

(a) Protection against the effects of noise exposure shall be provided when the sound levels exceed those shown in Table 1 of this section (page 42) when measured on the "A" scale of a standard sound level meter at slow response. When noise levels are determined by octave band analysis, the equivalent A-weighted sound level may be determined as follows:



Equivalent sound level contours. Octave band sound pressure levels may be converted to the equivalent A-weighted sound level by plotting them on this graph and noting the A-weighted sound level corresponding to the point of highest penetration into the sound level contours. This equivalent A-weighted sound level, which may differ from the actual A-weighted sound level of the noise, is used to determine exposure limits from Table 1.

*Reprinted from FEDERAL REGISTER, Vol. 34, No. 96 - Tuesday, May 20, 1969 (As revised from FEDERAL REGISTER - Saturday, January 24, 1970).

(b) When employees are subjected to sound levels exceeding those listed in Table 1 (below), feasible administrative or engineering controls shall be utilized. If such controls fail to reduce sound levels within the levels of the table, personal protective equipment shall be provided and used to reduce sound levels within the levels of the table.

(c) If the variations in noise level involve maxima at intervals of one second or less, it is to be considered continuous.

(d) In all cases where the sound levels exceed the values shown herein, a continuing, effective hearing conservation program shall be administered.

Table 1

PERMISSIBLE NOISE EXPOSURES*

Duration Per Day, Hours	Sound Level dB (A)
8	90
6	92
4	95
3	97
2	100
1 1/2	102
1	105
1/2	110
1/4 or less	115

*When the daily noise exposure is composed of two or more periods of noise exposure of different levels, their combined effect should be considered, rather than the individual effect of each. If the sum of the following fractions: C1/T1 + C2/T2 ... Cn/Tn exceeds unity, then, the mixed exposure should be considered to exceed the limit value. Cn indicates the total time of exposure at a specified noise level, and Tn indicates the total time of exposure permitted at that level.

Exposure to impulsive or impact noise should not exceed 140 dB peak sound pressure level.

Occupational Safety and Health Administration: Sec. 1910.95, Occupational Noise Exposure is the same as the Walsh Healey Act described above. The number of workers covered was greatly expanded and the OSHA regulations also have stiffer penalities. Additional description is in SAE paper 700714, 9/14/70.

VEHICLE SOUND LEVEL COMMITTEE PUBLISHED DOCUMENTS

Number	Title	Date
J34	SAE Recommended Practice, EXTERIOR SOUND LEVEL MEASUREMENT FOR PLEASURE MOTORBOATS	4/73
J87	SAE Recommended Practice, EXTERIOR SOUND LEVEL FOR POWERED MOBILE CONSTRUCTION EQUIPMENT	11/72
J88	SAE Recommended Practice, EXTERIOR SOUND LEVEL MEASUREMENT PROCEDURE FOR POWERED MOBILE CONSTRUCTION EQUIPMENT	11/72
J184	SAE Recommended Practice, QUALIFYING A SOUND DATA ACQUISITION SYSTEM	9/70 Ed. 7/72
J377	SAE Standard, PERFORMANCE OF VEHICLE TRAFFIC HORNS	4/69
J672a	SAE Standard, EXTERIOR LOUDNESS EVALUATION OF HEAVY TRUCKS AND BUSES	3/68 Ed. 9/70
J986a	SAE Standard, SOUND LEVELS FOR PASSENGER CARS AND LIGHT TRUCKS	7/68 Ed. 7/72
J994a	SAE Recommended Practice, CRITERIA FOR BACK-UP ALARM DEVICES	10/71

Sound Level Reports

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SOCIETY OF AUTOMOTIVE ENGINEERS, INC.,
Two Pennsylvania Plaza, New York, N.Y. 10001

REPRINT

EXTERIOR SOUND LEVEL FOR HEAVY TRUCKS AND BUSES — SAE J366a

SAE Recommended Practice

Report of Vehicle Sound Level Committee approved July 1969 and last revised June 1971.

1. Introduction—This SAE Recommended Practice establishes the test procedure, environment, and instrumentation for determining the maximum exterior sound level for highway motor trucks, truck tractors, and buses. The Appendix contains the recommendations of SAE for maximum sound level.

2. Instrumentation—The following instrumentation shall be used, where applicable, for the measurement required:

2.1 A sound level meter which meets the requirements of International Electrotechnical Commission Publication 179, Precision Sound Level Meters, and ANSI S1.4-1961, General Purpose Sound Level Meters.

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

2.2 A sound level calibrator.

2.3 An engine-speed tachometer (see paragraph 4.1.1).

3. Test Site

3.1 A suitable test site shall consist of a level open space free of large reflecting surfaces, such as parked vehicles, signboards, buildings, or hillsides, located within 100 ft of either the vehicle path or the microphone. See Fig. 1.

3.2 The microphone shall be located 50 ft from the centerline of the vehicle path and 4 ft above the ground plane. The normal to the vehicle path from the microphone shall establish the microphone point on the vehicle path.

3.3 An acceleration point shall be established on the vehicle path 50 ft before the microphone point.

3.4 An end point shall be established on the vehicle path 100 ft from the acceleration point and 50 ft from the microphone point.

3.5 The end zone is the last 40 ft of vehicle path prior to the end point.

3.6 The measurement area shall be the triangular area formed by the acceleration point, the end point, and the microphone location.

3.7 The reference point on the vehicle, to indicate when the vehicle is at any of the points on the vehicle path, shall be the front of the vehicle except as follows:

3.7.1 If the horizontal distance from the front of the vehicle to the exhaust outlet is more than 200 in, tests shall be run using both the front and rear of the vehicle as reference points.

3.7.2 If the engine is located rearward to the center of the chassis, the rear of the vehicle shall be used as the reference point.

3.8 During measurement, the surface of the ground within the measurement area shall be free from powdery snow, long grass, loose soil, or ashes.

3.9 Because bystanders have an appreciable influence on meter response when they are in the vicinity of the vehicle or microphone, not more than one person, other than the observer reading the meter, shall be within 50 ft of the vehicle path or instrument, and that person shall be directly behind the observer reading the meter, on a line through the microphone and the observer.

3.10 The ambient sound level (including wind effects) coming from sources other than the vehicle being measured shall be at least 10 dB lower than the level of the tested vehicle.

3.11 The vehicle path shall be relatively smooth, dry concrete or asphalt, free of extraneous material such as gravel.

4. Procedure

4.1 Vehicle Operation—Full throttle acceleration and closed throttle deceleration tests are to be used. A beginning engine speed and proper gear ratio must be determined for use during measurements.

4.1.1 Select the highest rear axle and/or transmission gear ("highest gear" is used in the usual sense; it is synonymous to the lowest numerical ratio) and an initial vehicle speed such that at wide-open throttle the vehicle will accelerate from the acceleration point:

(a) Starting at no more than two-thirds of maximum rated or of governed engine speed.

(b) Reaching maximum rated or governed engine speed within the end zone.

(c) Without exceeding 35 mph before reaching the end point.

4.1.1.1 Should maximum rated or governed rpm be attained before reaching the end zone, decrease the approach rpm in 100 rpm increments until maximum rated or governed rpm is attained within the end zone.

4.1.1.2 Should maximum rated or governed rpm not be attained until beyond the end zone, select the next lower gear until maximum rated or governed rpm is attained within the end zone.

4.1.1.3 Should the lowest gear still result in reaching maximum rated or governed rpm beyond the permissible end zone, unload the vehicle and/or increase the approach rpm in 100 rpm increments until the maximum rated or governed rpm is reached within the end zone.

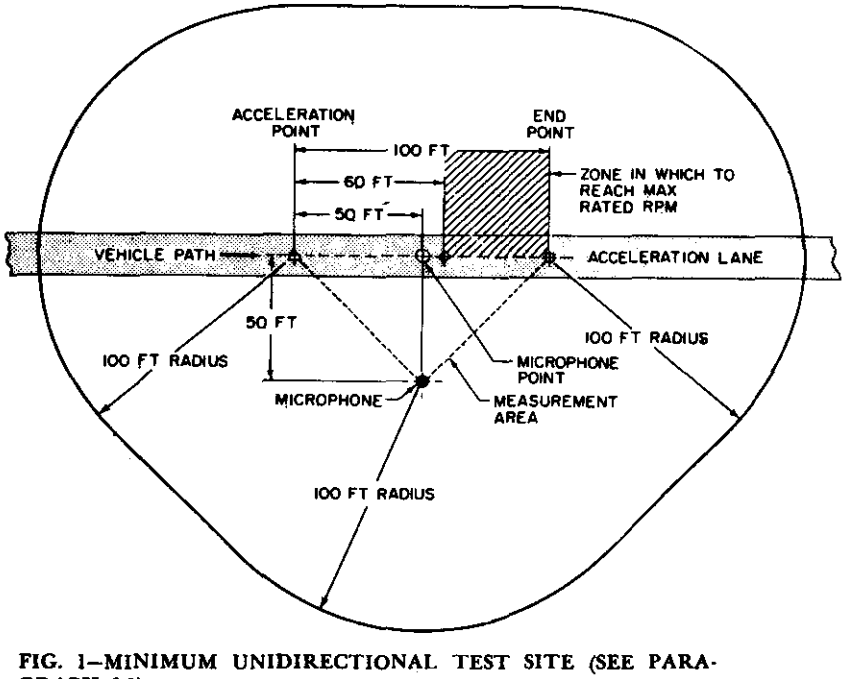

FIG. 1—MINIMUM UNIDIRECTIONAL TEST SITE (SEE PARAGRAPH 3.1)

4.1.2 For the acceleration test, approach the acceleration point using the engine speed and gear ratio selected in paragraph 4.1.1 and at the acceleration point rapidly establish wide-open throttle. The vehicle reference shall be as indicated in paragraph 3.7. Acceleration shall continue until maximum rated or governed engine speed is reached.

4.1.3 Wheel slip which affects maximum sound level must be avoided.

4.1.4 For the deceleration test, approach the microphone point at maximum rated or governed engine speed in the gear selected for the acceleration test. At the microphone point, close the throttle and allow the vehicle to decelerate to one-half of maximum rated or of governed engine speed. The vehicle reference shall be as indicated in paragraph 3.7. If the vehicle is equipped with an exhaust brake, this deceleration test is to be repeated with the brake full on immediately following closing of the throttle.

4.2 Measurements

4.2.1 The meter shall be set for "fast" response and the A-weighted network.

4.2.2 The meter shall be observed during the period while the vehicle is accelerating or decelerating. The applicable reading shall be the highest sound level obtained for the run, ignoring unrelated peaks due to extraneous ambient noises. Readings shall be taken on both sides of the vehicle.

4.2.3 The sound level for each side of the vehicle shall be the average of the two highest readings which are within 2 dB of each other. Report the sound level for the side of the vehicle with the highest readings.

5. General Comments—Measurements shall be made only when wind velocity is below 12 mph.

5.1 It is strongly recommended that technically trained personnel select equipment and that tests are conducted only by qualified persons trained in the current techniques of sound measurement.

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

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

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

5.2.3 Proper acoustical calibration procedure, to include the influence of extension cables, etc. Field calibration shall be made immediately before and after each test sequence. Internal calibration means is acceptable for field use, provided that external calibration is accomplished immediately before or after field use.

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

6. References—Suggested reference material is as follows:

ANSI S1.1-1960 Acoustical Terminology
ANSI S1.2-1967 Physical Measurement of Sound
ANSI S1.4-1961 General Purpore Sound Level Meters
IEC Publication 179, Precision Sound Level Meters

Applications for copies of these documents should be addressed to the American National Standards Institute, Inc., 1430 Broadway, New York, New York 10018.

APPENDIX

The SAE recommends that a maximum A-weighted sound level of 88 dB when measured in accordance with the test procedure described above be used as a reference in the design and development of heavy trucks and buses.

An additional 2 dB allowance over the sound level limit is recommended to provide for variations in test site, temperature gradients, test equipment, and inherent differences in nominally identical vehicles.

SOUND LEVEL FOR TRUCK CAB INTERIOR — SAE J336

SAE Recommended Practice

Report of Vehicle Sound Level Committee approved June 1968.

1. Introduction—This SAE Recommended Practice suggests design criteria for maximum truck cab interior sound levels and describes the equipment and procedure for determining this sound level. This practice applies to new motor trucks and truck-tractors and does not include construction and industrial machinery as outlined in SAE J919.

2. Design Criteria

2.1 It is recommended that the octave band pressure levels as set forth in the following tables be used as references in the design and development of new vehicles.

Standard Octave Bands		Preferred Center Frequencies	
Band	Level	Center Frequency	Level
37.5– 75	103	63	101.5
75 – 150	97.5	125	96
150 – 300	92	250	90.5
300 – 600	86.5	500	85
600 –1200	81	1000	79.5
1200 –2400	75.5	2000	74
2400 –4800	70	4000	70
4800 –9600	70	8000	70
(USAS Z24.10–1953)		(USAS S1.11–1966)	

2.2 Trucks meet the design criteria if the sum of the measured band pressure levels does not exceed the sum of the criteria band pressure levels in paragraph 2.1, provided that no measured band level exceeds the corresponding criteria band level by more than 3 db.

3. Equipment

3.1 A sound level meter which meets the requirements of International Electrotechnical Commission Publication 179, Precision Sound Level Meter.[1]

3.2 Alternatively a microphone/magnetic tape recorder/indicating meter system whose overall response meets the requirements of the International Electrotechnical Commission Publication 179, Precision Sound Level Meters.

3.3 A set of octave band-pass filters meeting the requirements set forth in USAS S1.11-1966 or Z24.10-1953.

3.4 A sound level calibrator.

3.5 An engine speed tachometer.

4. Procedure

This specification is based on octave band analysis data (in decibels) measured under the following conditions:

4.1 Locate the microphone 6 in. to the right of, in the same horizontal plane as, and directly in line with, the driver's ear. Orient the microphone vertically upwards.

4.2 Vehicle windows and vents are to be in the fully closed position with all accessories "off."

4.3 The tests are to be conducted on smooth, dry concrete or asphalt road surfaces. No large sound reflecting surfaces should be within 50 ft of the test vehicle. Wind velocity should not exceed 15 mph.

4.4 Select a transmission and/or axle gear ratio so that approximately 50 mph is obtained at rated engine speed.

4.5 Obtain the maximum band pressure level reading in each octave band during accelerations at full throttle from a beginning engine speed of one-half rated engine speed up to the rated speed.

4.6 The average of the two closest readings from three runs shall be reported for each band.

5. General Comments

5.1 Data may be read directly or may be tape recorded for later analysis.

5.2 Sound level tests may be conducted with any type trailer or body on the vehicle, or may be conducted in the "bob-tail" condition.

5.3 On vehicles equipped with radiator shutters, the shutter position causing the maximum sound level should be determined and the tests conducted accordingly.

5.4 It is strongly recommended that technically trained personnel select equipment and that tests be conducted only by qualified persons trained in the current techniques of sound measurement.

[1] Available from U.S.A. Standards Institute, 10 East 40th Street, New York, New York 10016.

SOUND LEVEL MEASUREMENTS AT THE OPERATOR STATION FOR AGRICULTURAL AND CONSTRUCTION EQUIPMENT — SAE J919a

SAE Recommended Practice

Report of Construction and Industrial Machinery Technical Committee approved May 1966 and last revised by Vehicle Sound Level Committee April 1971.

1. Introduction—This SAE Recommended Practice sets forth the instrumentation and procedure to be used in measuring sound levels at the operator station for agricultural and construction equipment, including mobile outdoor industrial equipment.

2. Instrumentation

2.1 A sound level meter which meets the requirements of International Electrotechnical Commission Publications (IEC) 179, Precision Sound Level Meters, and American National Standard ANSI S1.4—1961, General Purpose Sound Level Meters.

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

2.3 A sound level calibrator (see paragraph 4.2.4).

2.4 A calibrated windscreen (see paragraph 4.3).

2.5 A set of octave bandpass filters which meets the Class II requirements of ANSI S1.11—1966, Octave, Half-Octave, and Third-Octave Band Filter Sets.

2.6 An engine speed indicator (accurate within ±1% or ±10 rpm, whichever is greater).

2.7 An anemometer.

3. Procedure

3.1 Test Site

3.1.1 The test area shall consist of a flat open space free of large reflecting surfaces such as a signboard, building, or hillside located within 50 ft of the equipment.

3.1.2 For certification tests on rubber-tired vehicles, the test site shall be paved. For certification tests on tracked or steel-wheeled vehicles, the test site surface shall be smooth, hard packed dirt. In either case, the surface shall be free of acoustically absorptive materials such as snow or grass.

3.1.3 For job site tests, topographical conditions may not be fully controllable, but should conform as closely as practicable to conditions stated in paragraphs 3.1.1 and 3.1.2 and be described in detail.

3.2 Environment and Equipment Conditions

3.2.1 No person other than the vehicle operator shall be in the operator station area on vehicles with or without a cab. Bystanders may have an appreciable influence on instrumentation readings if such persons are in the vicinity of the equipment or the microphone.

3.2.2 The ambient sound level (including wind effects) due to sources other than equipment being measured shall be at least 10 dB(A) lower than the level of the tested equipment at the microphone location for the A weighted sound level readings. If octave band measurements are being taken, the ambient sound pressure level from other sources shall be at least 10 dB lower in each octave band.

3.2.3 The microphone shall be located as follows:

(a) On the middle line of the vehicle operator's normal seated position measure upward 28 in. from the seat reference point along a straight line tangent to the predominant front surface to the seat back.

(b) Forward 6 in. horizontally from the point location in paragraph 3.2.3(a).

(c) Right 10 in. horizontally from the point location in paragraph 3.2.3(b).

The seat reference point is defined as the point where the middle lines of the seat and backrest intersect. These middle lines shall be tangents to the predominant surfaces of the seat cushion and the seat back. The seat reference point is based on an undeflected cushion. Where the seat is of the buttock-pan type, with no back, consider the "back" to be a vertical plane, tangent to the rear of the pan. If more details are desired on the operator's seat dimensions, SAE J898 and 899 may be referred to for specific details. These dimensions take into consideration "operator slump" and "cushion deflection."

Adjustable seats shall be placed at the midpoint of their ranges for the calculation of this microphone location point. If the seat cushion is directly attached to a movable suspension system, then the range of travel shall be determined and the midpoint location be used to determine the seat reference point location relative to the vehicle. During the test the adjustable seats may be adjusted to suit the individual operator, providing that his final position for the test with the vehicle stationary places his right ear 6 in. (±1 in.) to the left of the microphone. The ear shall also be in a horizontal plane (±1 in.) with reference to the microphone location.

The dimensions of the vehicle operator should be as close as practical to the 50th percentile male. The operator's eye location dimension for a sitting clothed male (reference SAE J833) shall fall inside the 5th percentile to the 95th percentile male range.

3.2.4 When the test vehicle has a cab, measurements are to be taken with windows, doors, and vents in a fully closed position and all cab accessories turned on (except radio). If the vehicle does not have air conditioning, then the test shall also be run with windows, doors, and vents in a fully open position and all accessories turned off.

3.2.5 The vehicle shall be at a stabilized operating temperature during the test and must not be operated in a manner such that the break-in procedure specified by the manufacturer is violated.

3.3 Stationary Certification Tests—Measurements shall be made under the following conditions:

3.3.1 Maximum attainable governed engine speed at no load. Vehicles that have major noise generating machinery, such as an elevating scraper, combine, or field cutter, shall have this machinery in operation during the test.

3.3.2 Maximum attainable governed engine speed at torque converter stall conditions (make this test where possible).

3.3.3 Maximum power take-off load at rated engine speed (make this test where possible).

3.4 Moving Test

3.4.1 For a moving certification test, the vehicle shall be operated in an intermediate forward gear over the surface specified in paragraph 3.1.2. The engine shall be operated at full governed control setting loaded with any combination of rolling resistance, blading, drag load, or vehicle brakes to obtain rated engine speed. Intermediate is intended to mean the third gear ratio for machines with five or six gear ratios, fourth gear ratio for machines with seven or eight gear ratios, etc. (Gear ratio refers to overall gear reductions.) Hydrostatic or electric drive equipment will be operated at approximately one-half their maximum ground speed. If the condition of rated engine speed at load cannot be obtained due to stall (for instance, as on some loaders), the equipment shall be operated in the same intermediate gear ratio at maximum obtainable speed and no load. Equipment that has major noise generating machinery, such as elevating scraper or combine, shall have this machinery in operation during these tests.

3.4.2 For job site tests, the vehicle shall be operated over a path of travel and in a manner most typical of its application on that job. When this type of test is requested, the conditions of operation and test site description shall be specified in detail so that the conditions that may have an effect on the level of the measurements are quite self-evident.

3.4.3 The above prescribed operating conditions will normally result in noise levels representative of the vehicle and shall be used in the noise level evaluation of the vehicle. However, if other operating conditions are found to produce appreciably greater noise levels, then they shall be measured and recorded for reference purposes only.

3.5 Data Collection

3.5.1 Sound level measurements shall be taken using the A-weighting network with the meter set for slow or equivalent meter response. The number of readings taken for each test condition shall be at least equal to the range of fluctuation of the meter in dB. The sound levels reported for each test condition shall be an average of all readings taken for that particular test condition.

3.5.2 Engine speed shall be monitored with a speed indicator and recorded.

3.5.3 If a more detailed analysis of the sound spectrum is required, octave band measurements shall be made over the center frequencies of 63-8000 Hz, using the slow or equivalent meter response setting.

4. General Comments

4.1 It is strongly recommended that technically trained personnel select the equipment and that the tests be conducted only by qualified persons trained in the current techniques of sound measurement.

4.2 Proper usage of all test instrumentation is essential to obtain

valid measurements. Operating manuals or other literature furnished by the instrument manufacturer should be referred to for both recommended operation of the instrument and precautions to be observed. Specific items to be considered are:

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

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

4.2.3 Proper signal levels, terminating impedances, and cable length on multi-instrument measurement systems.

4.2.4 Proper acoustical calibration procedure, to include the influence of extension cables, etc. Field calibrations shall be made immediately before and after each test sequence. Internal calibration means is acceptable for field use, provided that external calibration is accomplished immediately before or after field use.

4.3 When using a windscreen it should be calibrated for the type of noise source being measured and data corrected if necessary. It is recommended that measurements be made only when wind velocity is below 12 mph.

5. Reference Material—Suggested reference material is as follows:

ANSI S1.1—1960 Acoustical Terminology.

ANSI S1.2—1962 Physical Measurement of Sound.

ANSI S1.4—1961 General Purpose Sound Level Meters.

ANSI S1.11—1966 Octave, Half-Octave and Third Octave Band Filter Set.

International Electrotechnical Commission Publication 179 Precision Sound Level Meters (available from ANSI).

Applications for copies of these documents should be addressed to the American National Standards Institute, Inc., 1430 Broadway, New York, New York 10018.

SOUND LEVELS FOR ENGINE POWERED EQUIPMENT—SAE J952b

SAE Standard

Report of Construction and Industrial Machinery Technical Committee approved May 1966 and last revised by Vehicle Sound Level Committee January 1969.

1. Introduction—This SAE Standard establishes maximum sound levels for engine powered equipment and describes the test procedure, environment, and instrumentation for determining these sound levels. It does not include machinery designed for operation on highways or within factories and building areas.

2. Maximum Sound Levels—See paragraph 5.2 and Table 1.

3. Instrumentation

3.1 A sound level meter which meets the requirements of International Electrotechnical Commission Publication 179, Precision Sound Level Meters.

3.2 A sound level calibrator (see paragraph 5.5).

3.3 A calibrated windscreen (see paragraph 5.4).

4. Procedure

4.1 **Test Site**—The test area shall consist of a flat open space free of any large reflecting surfaces such as a signboard, building, or hillside located within 100 ft of either the microphone or the equipment being recorded.

4.1.1 Bystanders may have an appreciable influence on meter response if such persons are in the vicinity of the equipment or the microphone. No person other than the observer reading the meter shall be near the microphone.

4.1.2 The ambient sound level (including wind effects) due to sources other than the equipment being measured shall be at least 10 dbA lower than the level of the tested equipment.

4.1.3 The path of equipment travel shall be over a surface which is typical of the particular machine application.

4.2 **Equipment Operations**—Operate the equipment at the combination of load and speed which produces the maximum sound level without violating the manufacturer's operation specifications.

4.3 **Measurements**

4.3.1 The microphone shall be located at a height of 4 ft above the ground plane.

4.3.2 The meter shall be set for "fast" response and the A-weighting network.

4.3.3 For equipment which is not traveling, record the highest sound level obtained at 50 ft from the nearest surface of the equipment.

4.3.4 For traveling equipment, take measurements at 50 ft normal from the centerline of the path of straight line travel. The applicable reading will be the highest sound level obtained from the loudest side as the equipment moves along the line of travel.

4.3.5 The sound level which is reported shall be the average of the two highest applicable readings which are within 2 db of each other.

5. General Comments

5.1 It is strongly recommended that technically trained personnel select equipment and that tests be conducted only by qualified persons trained in the current techniques of sound measurement.

5.2 An additional 2 db allowance over the sound level limits is recommended to provide for variations in test site, vehicle operation, temperature gradients, wind velocity gradients, test equipment, and inherent differences in nominally identical vehicles.

5.3 Instrument manufacturer's specifications for orientation of the microphone relative to the source of sound and the location of the observer relative to the meter should be adhered to.

5.4 When a windscreen is required, a previously calibrated windscreen should be used. It is recommended that measurements be made only when wind velocity is below 12 mph.

5.5 Manufacturer's recommended calibration practice of the instruments shoud be followed. Field calibration should be made immediately before and after each test sequence. Either an external calibrator or internal calibration means is acceptable for field use, providing that external calibrating is accomplished before or after field use.

5.6 Horsepower sizes utilized in determining equipment categories in paragraph 2 shall be in accordance with SAE J816 or SAE J607.

6. Reference Material—Suggested reference material is as follows:

USASI S1.1-1960, Acoustical Terminology.

USASI S1.2-1962, Physical Measurement of Sound.

International Electrotechnical Commission Publication 179, Precision Sound Level Meters (available from USASI).

(Applications for copies of these documents should be addressed to U.S.A. Standards Institute, 10 East 40th Street, New York, N. Y. 10016)

TABLE 1

Type of Equipment	Max Sound Level dbA at 50 ft (A-Weighting Network)
1. Construction and industrial machinery encompassing only mobile equipment, powered by internal combustion engines, such as crawler tractors, dozers, loaders, power shovels, and cranes, motor graders, paving machines, off-highway trucks, ditchers, trenchers, compactors, scrapers, and wagons	88
2. Engine powered equipment of 5 hp or less intended for use in residential areas at frequent intervals. Typical pieces of such equipment are lawn mowers, small garden tools, riding tractors, and snow removal equipment. This specifically excludes commercial equipment not intended for frequent use in residential areas	70
3. Engine powered equipment exceeding 5 hp but not greater than 20 hp intended for use in residential areas at frequent intervals. Typical pieces of such equipment are lawn mowers, small garden tools, riding tractors, and snow removal equipment. This specifically excludes commercial equipment not intended for use in residential areas	78
4. Engine powered commercial equipment of 20 hp or less intended for infrequent use in a residential area	88
5. Farm and light industrial tractors	88