OAR 340-035-0030
Table 2
In-Use Road Vehicle Standards
Stationary Test

Model Year	Maximum Noise Level (dBA)	Minimum Distance from Vehicle to Measurement Point
All Vehicles Described in ORS 481.205(2)		
Before 1976	94	25 feet (7.6 meters)
1976 and after	91	25 feet (7.6 meters)
All Other Trucks in Excess of 8,000 pounds (3629 kg.) GVRW		
Before 1976	94	25 feet (7.6 meters)
1976-1981	91	25 feet (7.6 meters)
After 1981	88	25 feet (7.6 meters)
Motorcycles		
1975 and Before	102	20 inches (1/2 meter)
After 1975	99	20 inches (1/2 meter)
Front-engine Automobiles, Light Trucks, All Other Front-engine Road Vehicles		
All	95	20 inches (1/2 meter)
Rear-engine Automobiles, Light Trucks and All Other Front-engine Road Vehicles		
All	95	20 inches (1/2 meter)
Buses as Defined Under ORS 481.030		
Before 1976	94	25 feet (7.6 meters)
1976 and After	91	25 feet (7.6 meters)

OAR 340-035-0030
Table 3
In-Use Road Vehicle Standards
Moving Test at 50 feet (15.2 meters) or Greater at Vehicle Speed

Operating Conditions	Trucks and Buses Exceeding 10,000 pounds GVWR	Automobiles and Light Trucks	Motorcycles
Posted 45 mph or less Under any Grade, Load, Acceleration or Deceleration	86	72	78
Posted Greater Than 45 mpg Under any Grade, Load, Acceleration or Deceleration	90	78	62
Moving at 35 mph or Less on Level Roadway Under Constant Speed More than 200 Feet From Stop	84	70	74

OAR 340-035-0030
Table 4
Off-Road Recreational Vehicle Standards

Allowable Noise Limits

Model Year	Maximum Noise Level (dBA and distance from vehicle to measuring point)	
	Stationary Test 20 inches (.5 meters)	Moving Test at 50 feet (15.2 meters)
Motorcycles		
1975 and before	102	85
After 1975	99	82
Snowmobiles		
1971 and before	---	86
1972-1975	---	84
After 1975	---	80
Boats		
Underwater exhaust - all	100	84
Atmosphere exhaust - all	100	84
All Others		
Front engine - all	95	78
Mid and Rear Engines - all	97	78

OAR 340-035-0030
Table 5
Ambient Standards for Vehicles Operated Near Noise Sensitive Property

Allowable Noise Limits

Time	Maximum Noise Level
7:00 a.m. – 10:00 p.m.	60
10:00 p.m. – 7:00 a.m.	55

OAR 340-035-0030
Table 6
Auxiliary Equipment Driven by Primary Engine Noise Standards

Stationary Test at 50 feet (15.2 meters) or Greater

Model Year	Maximum Noise Level dBA
Before 1976	88
1976-1978	85
After 1978	82

Sound Measurement Procedures Manual

NPCS - 1

DEQ

State of Oregon
Department of Environmental Quality

REVISION RECORD

INSTRUCTIONS FOR USE: All revisions of this manual will be numbered to assure each manual holder that he has received all revisions. The date and initials of the person inserting revisions to the manual should be entered on this revision record opposite the appropriate revision number. If the sequence is broken, copies of the missing revisions may be requested from the Noise Control Section.

Rev. No.	Date Inserted	Initials	
1.	4-30-74	JH	[illegible]
2.	8-16-74	JH	[illegible]
3.	11-25-74	NT	[illegible]
4.	8-27-76	JH	EQC Amendments
5.	5-6-83	JH	EQC Amendments
6.			
7.			
8.			
9.			
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11.			
12.			
13.			
14.			
15.			
16.			
17.			
18.			
19.			

FOREWORD

The Sound Measurement Procedures Manual has been prepared to specify the equipment to be used and the procedures to be followed when measuring environmental noise. The procedures established in the manual, when carefully followed, will ensure that the noise readings obtained are accurate, will support enforcement action, and aid in reducing environmental noise.

The scope of this manual includes industrial noise, commercial noise, noise from races and racetracks, noise from public roads and ambient noise measurements. Individual motor vehicle noise measurements are covered in a separate manual.

The objective of the manual is to establish procedures to implement the provisions of the Environmental Quality Commission. Further, if the practices and procedures herein are adhered to, the result will be a uniform enforcement program which will accomplish the intent of the Legislature and fulfill the Commission's responsibility under ORS Chapter 467.

Office of the Administrator
Air Quality Control Division
Department of Environmental Quality

TABLE OF CONTENTS

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

Policy

1.1.1 The Department of Environmental Quality, through the Noise Pollution Control Section shall establish a noise measurement program to implement the laws and regulations applying to environmental noise.

1.1.2 The Noise Pollution Control Section shall be responsible for the conformity of environmental noise measurement.

1.1.3 This manual contains procedures for the Noise Pollution Control Section, and all other persons taking environmental noise measurements. Guidance is provided in the "Comments".

1.2 Authority

Statutory and administrative law governing authority to the guidance and direction contained in the following sources:

a. Oregon Revised Statutes, Chapter 467, Sections 467.010, 467.020, 467.030, 467.040, 467.050, 467.990.

b. Oregon Administrative Rules, Chapter 340, Division 35, Department of Environmental Quality.

Instruments and Training

1.3.1 Specific requirements for instruments and personnel are defined under procedure manual, Noise Pollution Control Section - 2, Requirements for Sound Measuring Instruments and Personnel.

CHAPTER 2

INSTRUMENTATION

Sound Level Meters

The specifications for sound level meters (SLM) are defined in manual Noise Pollution Control Section (NPCS-2) Requirements for Sound Measuring Instruments and Personnel. The minimum meter required is a Type II as defined by American National Standard Institute Number S1.4-1971.

2.2 Accessories

The minimum accessories shall be a windscreen and an acoustically coupled calibrator.

Comment: Additional accessories that have been found to be valuable in gathering data are tabulated below:

(1) Noise data forms
(2) Clipboard
(3) Tripod
(4) Wind meter
(5) Sling psychrometer
(6) Screwdriver
(7) Spare batteries
(8) Watch with sweep second hand or digital equivalent

Tape Recorders and Level Recorders

Recording systems shall conform to NPCS-2.

Comment: The recording system should be able to duplicate the measurements as taken in the field. For tape recorders, a table of frequency response tolerances is given in SAE standards. Graphic level recorder systems standards are also described in the manual.

Octave Band Filter Sets

The octave band filter sets shall be those defined in NPCS-2.

Comment: These sets may either be integral to a sound level meter or they may be a separate piece of equipment.

Special Study Instruments

Comment: In some instances, special types of equipment may be found to be useful in studying a noise problem. The Department has several specialized noise instruments to be used in study situations. These instruments include a random noise generator, a loud speaker system, and a one-third octave band filter set.

One-Third Octave Band Filter Sets

The one-third octave band filter sets shall be those defined in NPCS-2.

Comment: These sets may be integral to a sound level meter or they may be a separate piece of equipment. Sets shall contain the preferred one-third octave band filters.

Impulse Meters

Impulse meters shall be those defined in NPCS-2.

Comment: These meters are integral to some Type I precision sound level meters set for a peak unweighted response. Blasting impulse noise is measured on a standard Type I or Type II meter set to the "C" weighting scale and the "SLOW" dumping response.

CHAPTER 3

INSTRUMENT CALIBRATION

General

All types of sound level meters shall be field calibrated immediately prior to use, using the procedures described in the factory instruction manual.

Battery Check

Batteries in both the meter and the calibrator shall be checked before calibration.

Instrument Calibration

The instrument shall be set to the correct level range, weighting scale and meter response. The calibrator shall be placed on the microphone of the meter. The output indicated on the meter shall then be adjusted to the correct calibration level.

Annual Calibration

Within a year prior to use, each sound level meter, including octave band filter and calibrator, shall receive a laboratory calibration in accordance with the manufacturer's specifications. This calibration shall be traceable to the National Bureau of Standards.

Comment: An inspection label may be attached to each instrument set to determine when the calibration was performed.

CHAPTER 4

ENVIRONMENTAL NOISE MEASUREMENT

4.1 Application

This chapter applies to ambient measurements, noise emissions from industrial facilities, and commercial facilities, and to ambient noise limits from motor vehicles. Individual motor vehicle noise measurements, airports and racetracks are covered in separate manuals.

4.1.2 Persons selected to measure environmental noise shall meet the requirements of NPCS-2 Requirements for Sound Measuring Instruments and Personnel.

Site Selection

4.2.1 The measurement location shall be at any point, no more than 25 feet from the noise sensitive building where the noise level is generally greatest, as illustrated in Figure 4-1.

If the noise sensitive building is closer than 25 feet from the property line, the measurement location shall be at any point on the property line, providing it is no more than 25 feet from the building, or at any other point within the noise sensitive property no more than 25 feet from the noise sensitive building, wherever the noise level is generally greatest, as illustrated in Figure 4-2. For any measurement, sound reflective surfaces shall not be closer than 10 feet from the measurement point.

Comment: Sound reflective surfaces do not include trees, shrubs, hedges or other vegetation.

Comment: Measurements for noise sensitive property on which the noise sensitive building lies within 10 feet of the noise sensitive property line may require sound level projection techniques described in 4.8 of the manual.

Equipment Set-Up

4.3.1 The sound level meter or microphone, either hand held or placed on a tripod, shall be 4 feet or more above the ground or floor surface.

4.3.2 Comment: A microphone extension cable may be used in areas where accessibility is difficult. Example: Changes in ground elevation, reflective surfaces, height or source or receiver.

Figure 4-1 Measurement Point 25 Feet From Building

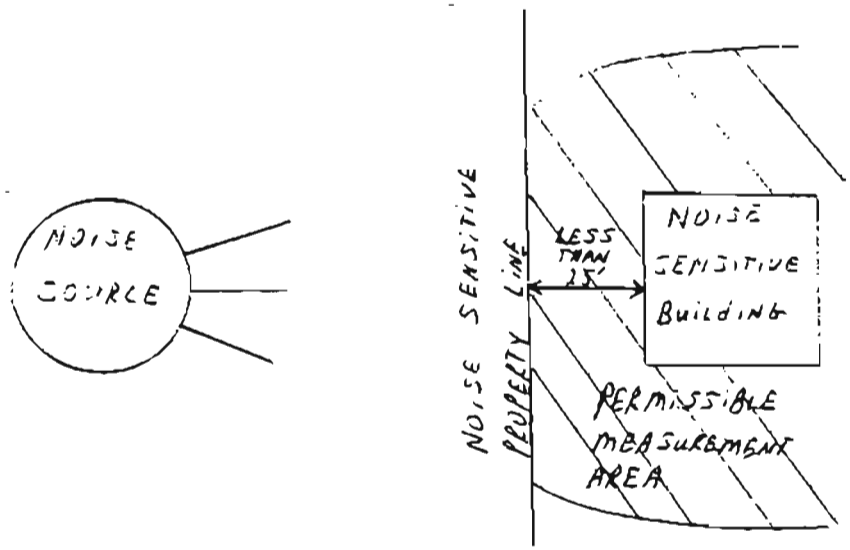


Figure 4-2 Measurement Point on Property Line

Instrument Calibration and Battery Check

4.4.1 Refer to Chapter 3 of NPCS-1 for instructions.

Noise Level Measurements

4.5.1 Comment: That information and data submitted to the Department should be recorded on Forms NPCS-4 and NPCS-5 as shown in Figure 4-3 and Figure 4-5, or on forms approved in writing by the Department.

4.5.2 Weather Conditions

a. The wind speed and direction shall be determined before measurements are taken and recorded on a form. Measurements shall not be taken when the wind speed exceeds 10 mph. The sound level meter windscreen shall always be installed on the microphone while taking measurements.

b. The relative humidity may be determined for the time measurements are taken. Measurements shall not be taken when precipitation affects results.

Comment: Measurements may be taken when the ground is wet if the readings are not influenced by motor vehicle tire noise on wet pavement.

c. Comment: The barometric pressure has an effect on the calibration level of most calibrators. This effect is usually small but can introduce some error under very low atmospheric pressure conditions or at high elevations. Typically no correction is needed at elevations below 2,000 feet. Above 2,000 feet elevation, the manufacturers correction factor must be applied to the instrument during calibration.

4.5.3 Determination of Meter Speed

a. Comment: The "FAST" meter speed is used for sounds of an essentially continuous nature. This speed is such that the indication instrument attains its final reading in approximately 0.2 seconds. In general, the "FAST" meter is used where meter fluctuations do not exceed 3 dB, or where the meter is required to follow fast changes in level such as an automobile or aircraft pass-by measurements.

b. Comment: The "SLOW" meter speed is used for sounds where the noise level fluctuates by + or - 3 dB and meter variations make the instrument display unreadable. The slower action of the meter provides an averaging effect that is helpful in measuring sounds of a rapidly varying nature or of low frequencies. However, for a noise pulse of 0.5 second duration, such a meter will typically read 2 to 6 dB low. It is not satisfactory for measuring intermittent sounds.

4.5.4 "A" Weighting Scale Measurements

Comment: Maximum noise level measurements with the "A" network weighting scale are taken with the sound level meter switched to the "A" network per the manufacturer's instructions. The meter must be properly positioned with respect to the noise source per the manufacturer's instructions. Information and data taken during the measurements should be recorded on Form NPCS-4 or equivalent as shown in Figure 4-3.

4.5.5 Statistical Noise

Comment: The statistical noise level is that noise level exceeded a stated percentage of the time. An $L_{10} = 65$ dBA means that in any consecutive 60 minute period of the day 65 dBA is equalled or exceeded only 10% of the time, or for a total of 6 minutes. Several procedures are in use by the Department to determine statistical noise levels and other methods may be approved in writing from the Department. Three acceptable procedures to determine the statistical noise level are presented in Section 6 of this Chapter. Information and data taken during the measurements should be recorded on Form NPCS-10-1 or equivalent as shown in Figure 4-9. Statistical calculations can be carried out on Forms NPCS-10-2 and NPCS-10-3 and should be summarized in "L" terminology on Form NPCS-4. An example of a completed Form NPCS-4 is presented in Figure 4.4.

4.5.6 Ambient Noise Determination

Comment: The ambient noise level is a composite of sounds from many sources near and afar. As the ambient noise level will be compared to the noise level with the source included in any consecutive 60 minute period, it is important that data is obtained in time periods of interest during the day and also both the week and

the weekend to obtain data which are representative. It is also important to note that the data must be taken without emphasis on either noise peaks or unusual quiet.

Measurements should not be taken in weather conditions which may create a bias in the data. Wet streets or snow accumulations could bias the data unless these conditions are typical for the community.

Measurements should be made at least at several appropriate locations within the sampling area under consideration. Measurements should be made randomly in the sense that each location and each sampling time has the same chance of being sampled and that the selection of any one factor in no way influences the choice of another. Measurements should be made on at least three separate days.

The ambient statistical noise levels obtained or predicted with the noise source in question operating, should include all noises generated by that source. This may include such sources as increased motor vehicle traffic noise, safety warning device noise, and other sounds that may be exempted from the rules due to other considerations.

Procedures to determine the L_{10} and L_{50}, statistical noise levels are presented in Section 6 of this Chapter. Information and data taken during the measurements should be recorded on Form NPCS-4 or equivalent as shown in Figure 4-4.

4.5.7 Octave Band Noise Measurement

Octave band noise measurements shall be made on an octave band frequency analyzer per document NPCS-2, Requirements for Sound Measuring Instruments and Personnel.

Comment: Octave band sound pressure levels may be measured in the same manner as the "A" weighting scale measurements, except that the octave band filters shall be used in place of the "A" weighting network. Information and data taken during the measurements should be recorded on Form NPCS-5 or equivalent as shown in Figure 4.5. An example of a completed form NPCS-5 is presented in Fig. 4-6.

4.5.8 Tape Recording

Comment: Tape recording of the noise and a calibration signal is optional. The tape recorder system must conform to the specifications defined in document NPCS-2 Requirements for Sound Measuring Instruments and Personnel.

4.5.9 One-Third Octave Band Noise Measurement

One-third octave band noise measurements shall be made on a one-third octave band frequency analyzer per document NPCS-2, Requirements for Sound Measuring Instruments and Personnel.

Comment: One-third octave band sound pressure levels may be measured in the same manner as the "A" weighting scale measurements, except that the one-third octave band filter shall be used in place of the "A" weighting network. Information and data taken during the measurements should be recorded on form NPCS-29 or equivalent as shown in Figure 4-7. An example is shown in Figure 4-8.

4.5.10 Impulse Measurements

Impulse measurements shall be made on meters per document NPCS-2, Requirements for Sound Measuring Instruments and Personnel. Impulse sound pressure levels are to be taken with the meter set to the linear unweighted scale with the peak detector circuit engaged for unweighted (dB) impulse measurements. For "C" weighted (dBC) impulse measurements the meter is set to the "C" weighting scale and the meter speed is set to the "SLOW" damping response.

Comment: Information and data should be recorded on Form NPCS-4 or equivalent as shown in Figure 4-3. An example of a completed form is presented in Figure 4-4.

DEPARTMENT OF ENVIRONMENTAL QUALITY

File _____

SOUND PRESSURE LEVEL DATA SHEETS

County

SOURCE _____ BY

DATE

SHEET

COMPLAINANT _____

COMPLAINT DATE _____

INSTRUMENTATION		
EQT	TYPE	SERIAL
SLM		
MIC		
FLTR		
CAL		
Windscreen ON OFF		

Time	Bat. Ck.	Cal. dB	°F dry bulb	°F wet bulb	% RH	Press. mm Hg	Wind mph	Wind Direct

Measurement Position	Meter Fast/Slow	A Scale	C Scale	Linear Scale	L_1	L_{10}	L_{50}	Peak Impulse

Comments _____

Form NPCS-4

INSTRUMENT SET-UP
CHECK-OFF LIST

- ☐ Site Selection
- ☐ SLM Position
- ☐ Battery Check
- ☐ Calibration Adjustment
- ☐ Wind Below 10 MPH
- ☐ Humidity Below 95%
- ☐ Windscreen

1. Days of Operation
   - A. Mon. - Fri.
   - B. Mon. - Sat.
   - C. Mon. - Sun.
2. Time of Operation
   - A. 8 a.m. - 5 p.m.
   - B. _ a.m. - _ p.m.
3. Number of Shifts
   - A. One
   - B. Two
   - C. Three
4. Distance from Receiver to source _____ feet.
5. Visibility to Source
   - A. Direct _____
   - B. Hill or Berm
   - C. Trees _____
   - D. Other _____
6. Zoning
   - A. Residence _____
   - B. Plant or Facility _____
7. Who came first?
   - A. Residence...Date _____
   - B. Plant or Facility _____
8. Petition Submitted
   - A. Yes... Number _____
   - B. No

SKETCH OF MEASUREMENT SITE AND SOURCE

REVERSE SIDE FORM NPCS-4
FIGURE 4-3

NPCS-4

DEPARTMENT OF ENVIRONMENTAL QUALITY

SOUND PRESSURE LEVEL DATA SHEETS

File Industry

County Multnomah

SOURCE Oregon Paving Co.
1000 SE 101st, Portland
Rock crusher

BY C. M. Sroka

DATE 6/6/74

SHEET 1/2

COMPLAINANT Mr. Eastland
155 SE Millman Dr, Portland

COMPLAINT DATE 5/10/74

INSTRUMENTATION		
EQT	TYPE	SERIAL
SLM	GR 1565B	
MIC	GR	
FLTR		
CAL	GR 1567	Del [illegible]
Windscreen (ON) OFF		

Time	Bat. Ck.	Cal. dB	°F dry bulb	°F wet bulb	% RH	Press. mm Hg	Wind mph	Wind Direct
1:45p	✓	114	67	51	29	—	0.5	W

Measurement Position	Meter Fast/Slow	A Scale	C Scale	Linear Scale	L_1	L_{10}	L_{50}	Peak Impulse
1	fast	78		85				106
2	fast				79	75	70	

Comments An occasional bus or truck; ambient noise without crusher operating is 51-57 dBA.

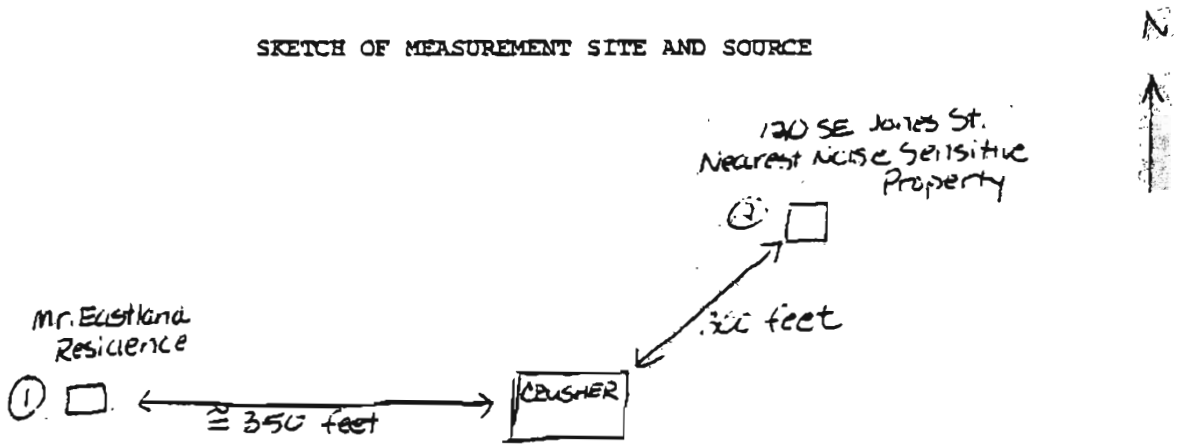
Example Form NPCS-4

INSTRUMENT SET-UP
CHECK-OFF LIST

- ☑ Site Selection
- ☑ SLM Position
- ☑ Battery Check
- ☑ Calibration Adjustment
- ☑ Wind Below 10 MPH
- ☑ Humidity Below 95%
- ☑ Windscreen

1. Days of Operation
   - (A) Mon. - Fri.
   - B. Mon. - Sat.
   - C. Mon. - Sun.
2. Time of Operation
   - A. 8 a.m. - 5 p.m.
   - (B) 6 a.m. - 9 p.m.
3. Number of Shifts
   - A. One
   - (B) Two
   - C. Three
4. Distance from Receiver to source 300-350 feet.
5. Visibility to Source
   - (A) Direct _____
   - B. Hill or Berm _____
   - C. Trees _____
   - D. Other _____
6. Zoning
   - (A) Residence _____
   - B. Plant or Facility _____
7. Who came first?
   - (A) Residence...Date _____
   - B. Plant or Facility
8. Petition Submitted
   - (A) Yes... Number 300 Sig?
   - B. No

SKETCH OF MEASUREMENT SITE AND SOURCE



Example Form NPCS-4
Figure 4-4 REVERSE SIDE FORM

DEPARTMENT OF ENVIRONMENTAL QUALITY

SOUND PRESSURE LEVEL DATA SHEETS

File _____

County _____

SOURCE _____

BY

DATE _____

SHEET 1

COMPLAINANT _____

COMPLAINT DATE _____

INSTRUMENTATION		
EQT	TYPE	SERIAL
SLM		
MIC		
FLTR		
CAL		

Windscreen ON OFF

Time	Bat. Ck.	Cal. dB	°F dry bulb	°F wet bulb	% RH	Press. mm Hg	Wind mph	Wind Direct

Position	Fast/ Slow	A Scale	Lin. Scale	31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz

Comments _____

Form NPCS-5
Figure 4-5

NPCS-5

INSTRUMENT SET-UP
CHECK-OFF LIST

- ☐ Site Selection
- ☐ SLM Position
- ☐ Battery Check
- ☐ Calibration Adjustment
- ☐ Wind Below 10 MPH
- ☐ Humidity Below 95%
- ☐ Windscreen

1. Days of Operation
   - A. Mon. - Fri.
   - B. Mon. - Sat.
   - C. Mon. - Sun.
2. Time of Operation
   - A. 8 a.m. - 5 p.m.
   - B. _ a.m. - _ p.m.
3. Number of Shifts
   - A. One
   - B. Two
   - C. Three
4. Distance from Receiver to source _____feet.
5. Visibility to Source
   - A. Direct _____
   - B. Hill or Berm _____
   - C. Trees _____
   - D. Other _____
6. Zoning
   - A. Residence _____
   - B. Plant or Facility _____
7. Who came first?
   - A. Residence...Date _____
   - B. Plant or Facility _____
8. Petition Submitted
   - A. Yes... Number _____
   - B. No

SKETCH OF MEASUREMENT SITE AND SOURCE

FIGURE 4-5
REVERSE SIDE FORM NPCS-5

DEPARTMENT OF ENVIRONMENTAL QUALITY

SOUND PRESSURE LEVEL DATA SHEETS

File Industry

County Lane

SOURCE Sam's Sawmill
1200 East Road
Eugene

BY LCVR - GCS

DATE 4/27/74

SHEET 1 / 1

COMPLAINANT Mr. Ed Jones
100 Martin St., Eugene

COMPLAINT DATE April 19, 1974

INSTRUMENTATION		
EQT	TYPE	SERIAL
SLM	G.R. 1933	2250 1591
MIC	G.R.	[illegible]
FLTR	G.R.	1250
CAL	G.R. [illegible]	[illegible]
Windscreen ON OFF		

Time	Bat. Ck.	Cal. dB	°F dry bulb	°F wet bulb	% RH	Press. mm Hg	Wind mph	Wind Direct
3:40 pm	OK	114	67	51	47	—	4	W
4:07 pm	OK	114.0						

Position	Fast/ Slow	A Scale	Lin. Scale	31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz
1	S	47	63	55	55	54	54	50	44	38	30	[illegible]

Comments Measurements taken during "blower" operation. Readings taken from 3:51 through 4:02 pm.

Example Form NPCS-5
Figure 4-6

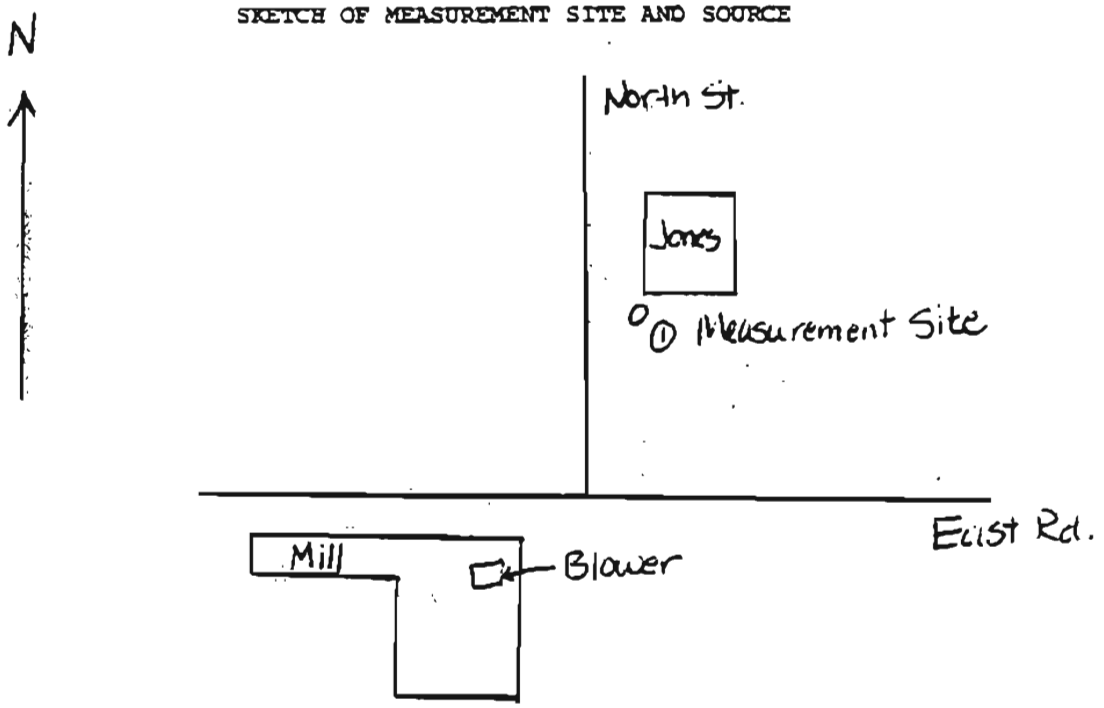
NPCS-5

INSTRUMENT SET-UP
CHECK-OFF LIST

- [x] Site Selection
- [x] SLM Position
- [x] Battery Check
- [x] Calibration Adjustment
- [x] Wind Below 10 MPH
- [x] Humidity Below 95%
- [x] Windscreen

1. Days of Operation
   - A. Mon. - Fri.
   - (B) Mon. - Sat.
   - C. Mon. - Sun.
2. Time of Operation
   - A. 8 a.m. - 5 p.m.
   - (B) 8 a.m. - 4 p.m.
3. Number of Shifts
   - A. One
   - (B) Two
   - C. Three
4. Distance from Receiver to source ≈300 feet.
5. Visibility to Source
   - A. Direct X
   - B. Hill or Berm
   - C. Trees
   - D. Other
6. Zoning
   - A. Residence X
   - B. Plant or Facility
7. Who came first?
   - (A) Residence...Date 1952
   - B. Plant or Facility
8. Petition Submitted
   - A. Yes... Number
   - (B) No

SKETCH OF MEASUREMENT SITE AND SOURCE



Example Form NPCS-5
Figure 4-6
REVERSE SIDE OF FORM

DEPARTMENT OF ENVIRONMENTAL QUALITY

1/3 OCTAVE BAND DATA SHEET

File

County _____

SOURCE _____ BY _____

_____ DATE

_____ SHEET

_____

COMPLAINANT _____

_____

COMPLAINT DATE _____

INSTRUMENTATION		
EQT	TYPE	SERIAL
SLM		
MIC		
FLTR		
CAL		

Windscreen ON OFF

Time	Bat. Ck.	Cal. dB	°F dry bulb	°F wet bulb	% RH	Press. mm Hg	Wind mph	Wind Direct

PREFERRED CENTER FREQUENCIES FOR 1/3 OCTAVE BANDS

osition	Lin. Scale	20 Hz	25 Hz	30 Hz	40 Hz	50 Hz	63 Hz	80 Hz	100 Hz	125 Hz	160 Hz	200 Hz	250 Hz	315 Hz	400 Hz
osition	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	10,000	12,500

omments _____

_____

_____

_____

Figure 4-7 Form NPCS-29

NPCS-29

DEPARTMENT OF ENVIRONMENTAL QUALITY

1/3 OCTAVE BAND DATA SHEET

I+C

File NP-ABC Lumber

County Coos

SOURCE ABC Lumber Co.
1000 "F" St.
Coos Bay, OR

BY B. Hammon

DATE 9-18-81

COMPLAINANT Mr. Joe Smith
1245 "D" St., Coos Bay

COMPLAINT DATE 9-16-81

INSTRUMENTATION		
EQT	TYPE	SERIAL
SLM	B+K 2209	396 472
MIC	B+K 4145	311 347
FLTR	B+K 1618	923111
CAL	B+K 4220	376042
MAG TAPE	B+K 7003	704619
Windscreen	(ON)	OFF

Time	Bat. Ck.	Cal. dB	°F dry bulb	°F wet bulb	% RH	Press. mm Hg	Wind mph	Wind Direct
2:00 PM	✓	124.0	66°	PARTLY CLOUDY			4-6	SW
3:10 PM	✓	124.0	69°	"			2-4	"

PREFERRED CENTER FREQUENCIES FOR /3 OCTAVE BANDS

Position	Lin. Scale	20 Hz	25 Hz	30 Hz	40 Hz	50 Hz	63 Hz	80 Hz	100 Hz	125 Hz	160 Hz	200 Hz	250 Hz	315 Hz	400 Hz
1	70	58	60	59	58	59	60	59	59	58	57	56	54	52	51

Position	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000		
1	50	48	46	45	53	43	41	40	40	37	38	36	37	32	28

Comments SAMPLE TAKEN 2:13 TO 2:35 PM PDT. PRIMARY IS A LARGE SAW. PRODUCES WHINE IN 1250 Hz. BAND

4.6 Statistical Noise Level Calculations

4.6.1 Hand Sample Method (Comment)

a. For this method use forms NPCS-10-1, NPCS-10-2, and NPCS-10-3 as shown in Figures 4-9 through 4-11 or equivalent.

b. Perform a short noise survey to determine the approximate range of sound levels produced by the noise source being investigated. Enter the approximate high and low noise levels as well as the central tendency on form NPCS-10-1. Use the minimum and maximum sound levels and the table at the back-bottom of form NPCS-10-1 to estimate the minimum number of good sound samples needed to be taken from the source in question. For example, in Figure 4-12 the noise varied from a high of approximately 67 dBA to a low of 61 dBA. This is a 6 dBA variation. The table on NPCS-10-1 indicates that a minimum of 132 good readings needs to be taken.

The table on NPCS-10-1 is designed to give an acceptable statistical confidence in the L_{10} and L_{50} noise level. For determining the L_1 noise level with confidence or for more complex noise sources, more noise samples than indicated in the table may be necessary.

c. Record the noise levels in dBA on Form NPCS-10-1 at five second intervals, at ten second intervals, or at fifteen second intervals. An example of such a measurement is presented in Figure 4-12. Note any unusual activity from the noise source in question. Also indicate all external or extraneous noise sources which may contaminate the noise reading. Examples include sounds from passing vehicle traffic and aircraft. The sound readings associated with these external sources will not be included in the statistical noise level calculations. If external sounds contaminate the measurements for a significant amount of time, it may be necessary to conduct the survey during a period of the day in which these other sources are absent or quieter.

d. Using Form NPCS-10-2, tally the recorded noise levels in 1 dBA increments as the example shows in Figure 4-13. Record on NPCS-2 only those sound levels which are legitimately associated with the source in question, ignoring all other contaminating sound levels.

In the "Number of Readings" column, sum the total readings at each dBA level. Using the "Number Greater Than" column, calculate the number of readings taken that are greater than each particular level. For example, in Figure 4-13 there are no readings greater than 74 dBA, hence the "Number Greater Than " is zero. There is one reading taken at a level greater than 73 dBA, and three (1 plus 2) readings greater than 72 dBA.

The percent greater than (% Greater Than) column contains the statistical percent for each dBA level. The percent is calculated by dividing the numbers in the "Number Greater Than" column by the total number of readings times 100. For example, the percent of 73 dBA is calculated as (1/194) x 100 = 0.5%, and the percent at 72 dBA is (3/194) x 100 = 1.5%.

e. Using Form NPCS-10-3, the dBA levels versus the "percent greater than" numbers are plotted. An example of this is shown in Figure 4-14.

From the resulting graph, the statistical noise level at any required percentage may be found. For example, the L_{50} and L_{10} are found to be 63 dBA and 66 dBA, respectively. Note that a normalized or randomly varying noise source will result in a straight line when plotted on form NPCS-10-3.

f. The results from the statistical survey are then summarized on form NPCS-4 (see Figure 4-4). On the back of NPCS-4 a sketch of the measurement site should be drawn.

g. A typical noise survey will require approximately 20 minutes of measuring to record the required number of samples at a 5-second sample interval. However, the noise standards for industrial and commercial noise sources (OAR 340-35-035) are specified for a one-hour (60 minute) period. Therefore, the noise investigator must ensure that the noise survey represents sounds that are typical of a full 60-minute operation of the noise source. If the source significantly changes its operation for the remainder of the hour, it is recommended that a full 60 minutes of samples are measured and recorded for the statistical analysis.

h. The documentation of the L_1 statistical noise level is often better accomplished by the "time above" method. For noise sources that operate for a short period of time at a constant sound level, an accurate determination of the L_1 noise level can be determined by measuring the total amount of time the noise source operates in a one-hour period. If

the source operates for a period of 36 seconds or greater within the hour (but less than 6 minutes), then the L_1 is equal to the measured noise level. If the source operates for 6 minutes or more during the hour, then the measured level is the L_{10} statistical noise level.

4.6.2 Noise Exposure Counter or Monitor Method

Comment: Statistical noise levels may be obtained through the use of several commercially designed devices that sample and classify the data.

4.6.3 Programmable Calculator Method

Comment: The noise staff of the Department has developed a program to calculate statistical noise levels on a Wang 600 series programmable calculator. This method will digitally make the necessary calculations after the analog noise data has been converted to digital data. As this method is specialized to the Department's facilities, it will not be presented here. A complete explanation of the method and program listing is on file at the Department in Manual NPCS-22, Analysis of Ambient Noise with the Wang 600 Series Programmable Calculator.

DEPARTMENT OF ENVIRONMENTAL QUALITY

STATISTICAL NOISE SURVEY

SOURCE: _____ DATE:

_____ BY:

MEASUREMENT SITE: _____ COUNTY: _____

_____ SHEET: /

Time	Bat.	Calibration dB	F dry bulb	F wet bulb	%RH	Press. mm Hg.	Wind MPH	Wind direct.

INSTRUMENTATION		
EQUT	TYPE	SERIAL
SLM		
MIC		
CAL		

WINDSCREEN: ON OFF

~ Range of Noise: Hi _____ dBA Low _____ dBA Central Tend. _____ dBA

Start Time: _____ Sample Interval: 5 10 15 seconds

DATA POINTS	SOUND PRESSURE LEVEL dBA					
1 - 6						
7 - 12						
13 - 18						
19 - 24						
25 - 30						
31 - 36						
37 - 42						
43 - 48						
47 - 54						
55 - 60						
61 - 66						
67 - 72						
73 - 78						
79 - 84						
85 - 90						
91 - 96						
97 - 102						
103 - 108						
109 - 114						
115 - 120						
121 - 126						
127 - 132						

Figure 4-9
Form NPCS-10-1

Note: See back for the minimum number of samples.
Indicate all missing data points and give an explanation.

NPCS-10-1

6/76

133 - 138						
139 - 144						
145 - 150						
151 - 156						
157 - 162						
163 - 168						
169 - 174						
175 - 180						
181 - 186						
187 - 192						
193 - 198						
199 - 204						
205 - 210						
211 - 216						
217 - 222						
223 - 228						
229 - 234						
235 - 240						
241 - 246						
247 - 252						
253 - 258						
259 - 264						
265 - 270						
271 - 276						
277 - 282						
283 - 288						
289 - 294						
295 - 300						
301 - 306						
307 - 312						
313 - 318						
319 - 324						
325 - 330						
331 - 336						

Figure 4-9
Reverse Side Form NPCS-10-1

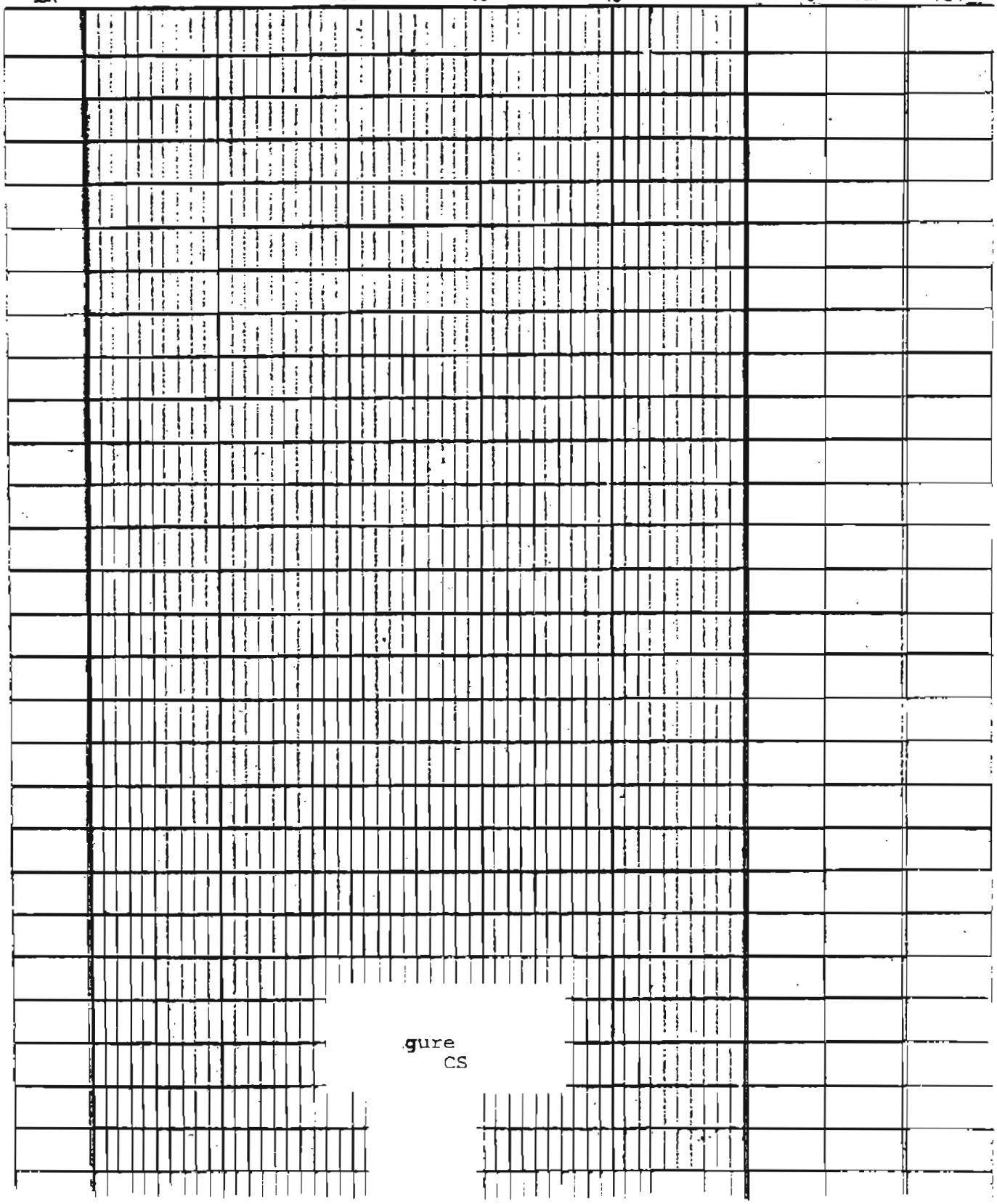
Maximum - Minimum Levels (difference in range)													
0-8	9	10	11	12	13	14	15	16	17	18	19	20	21
132	138	174	210	246	288	336	384	438	498	558	618	684	756
Minimum Number "Good" Samples													

Note: Indicate all missing data points and give an explanation. Additional data points may be needed to document an L_1 violation.

NPCS-10-1

DEPARTMEN OF ENVIRONMENTAL QUALITY
STATISTICAL COMPUTATION SHEE

te. _____ rce: _____ /



gure
CS

NPCS 2 6/76

Figure 4-11
Form NPCS-10-3

SOURCE: ACME WOOD PRODUCTS INC. DATE: 9-16-81

1581 S.W. 76TH (DEBARKER, SAW, CHIPPER) BY: GTW

MEASUREMENT SITE: SITE 1, MR & MRS. JONES' NSP COUNTY: MULT.

1576 S.W. 76TH, PORTLAND SHEET: 2/4

Time	Bat.	Calibration dB	F dry bulb	F		Press. mm Hg.	Wind MPH	Wind direct.
1410	✓	114.0					0-5	NW
1515	✓	114.0					2-6	NW

~ Range of Noise: Hi 67 dBA Low 61 dBA Central Tend. 63 dBA

Start Time: 1420 PDT Sample Interval: (5) 10 15 seconds

INSTRUMENTATION		
EQUT	TYPE	SERIAL
SLM	GR 1565	12345
MIC	1"	
CAL	GR 1987	1790

WINDSCREEN (ON) OFF

DATA POINTS	SOUND PRESSURE LEVEL dBA					
1 - 6	65	63	62	61	64	65
7 - 12	63	61	65	CAR	CAR	64
13 - 18	63	62	70	65	63	62
19 - 24	70	62	DOG	64	63	61
25 - 30	62	63	63	61	67	67
31 - 36	TRUCK →	T	T	64	66	65
37 - 42	62	63	64	63	62	64
43 - 48	63	63	64	63	73 R	62
47 - 54	63	63	65	62	64	63
55 - 60	61	64	65	63	63	65
61 - 66	65	66	64	61	62	66
67 - 72	60	61	63	63	64	70
73 - 78	72	61	73 R	74 R	64	64
79 - 84	63	62	60	65	62	64
85 - 90	61	62	67	63	JET	JET →
91 - 96	JET	JET	65	64	64	64
97 - 102	70 R	63	64	63	62	65
103 - 108	66	65	66	62	64	63
109 - 114	64	64	62	63	65	64
115 - 120	64	67	63	64	DOG	DOG
121 - 126	65	66	67	64	66	69
127 - 132	69	CAR	CAR	63	66	64

Note: See back for the minimum number of samples. NPCS-10-1
Indicate all missing data points and give an explanation.

6/76

133 - 138	63	66	65	64	63	66
139 - 144	62	63	65	64	63	64
145 - 150	64	64	65	66	62	64
151 - 156	66	63	68	63	63	63
157 - 162	62	63	64	63	63	62
163 - 168	63	65	64	62	63	68
169 - 174	← COMPLAINANT		TALKING →		64	61
175 - 180	63	63	63	64	63	65
181 - 186	64	61	61	BIRDS →	B	63
187 - 192	64	63	64	62	65	64
193 - 198	62	64	63	62	64	62
199 - 204	CAR	CAR	63	64	60	63
205 - 210	64	62	62	TRUCK →	T	T
211 - 216	T	T	T	63	64	64
217 - 222	69	63	65	63	65	63
223 - 228						
229 - 234						
235 - 240						
241 - 246						
247 - 252						
253 - 258						
259 - 264						
265 - 270						
271 - 276						
277 - 282						
283 - 288						
289 - 294						
295 - 300						
301 - 306						
307 - 312						
313 - 318						
319 - 324						
325 - 330						
331 - 336						

Maximum - Minimum Levels (difference in range)

0-8	9	10	11	12	13	14	15	16	17	18	19	20	21
132	138	174	210	246	288	336	384	438	498	558	618	684	756

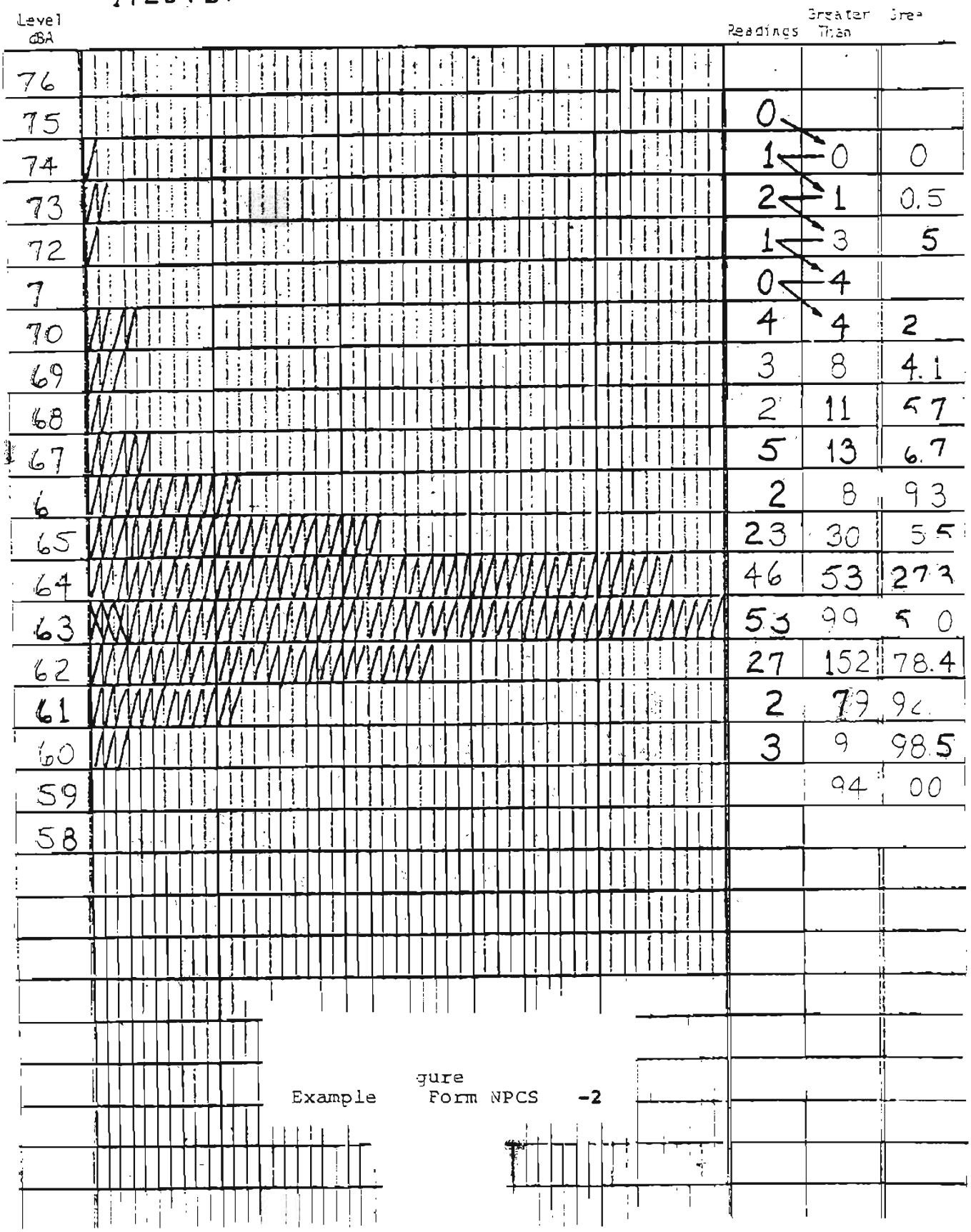
Minimum Number "Good" Samples

Additional data

NPCS-10-1

ICAL COMPI

Date 9-16-81 1420 PDT Source: ACME WOOD PRODUCTS INC. Sheet 3/4



Level dBA	Readings	Greater Than	Grea
76			
75	0		
74	1	0	0
73	2	1	0.5
72	1	3	5
7	0	4	
70	4	4	2
69	3	8	4.1
68	2	11	57
67	5	13	6.7
6	2	8	93
65	23	30	55
64	46	53	273
63	53	99	50
62	27	152	78.4
61	2	79	9[illegible]
60	3	9	98.5
59		94	00
58			

Example gure Form NPCS -2

NPCS 2

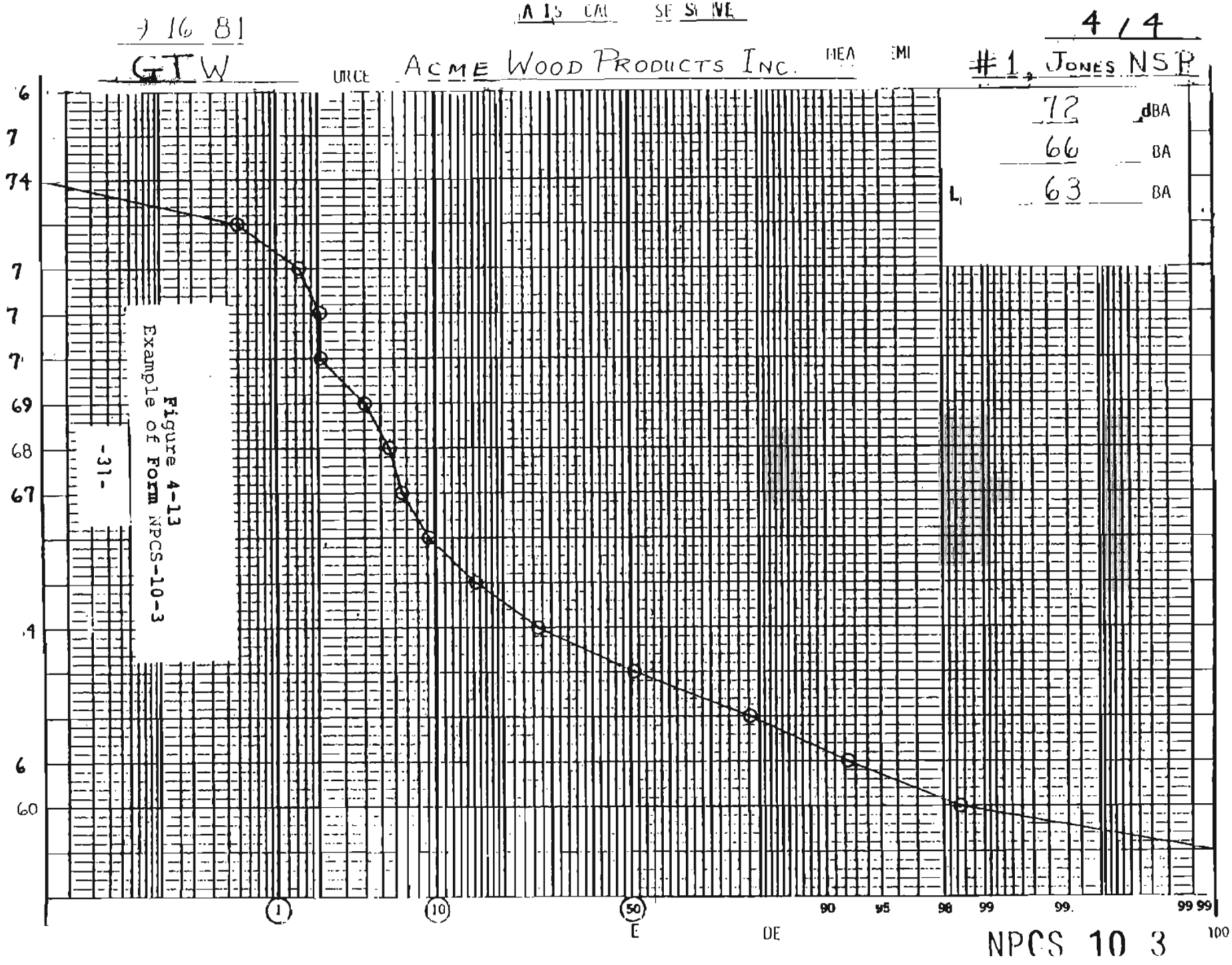


Figure 4-13
Example of Form NPCS-10-3

4.8.1 Point Source

Comment: The sound pressure level at a point r feet from a point source can be calculated from a sound pressure level measurement at a point r_o feet from the point source using the following equation:

$$SPL = SPL_o - 20 \log (r/r_o)$$

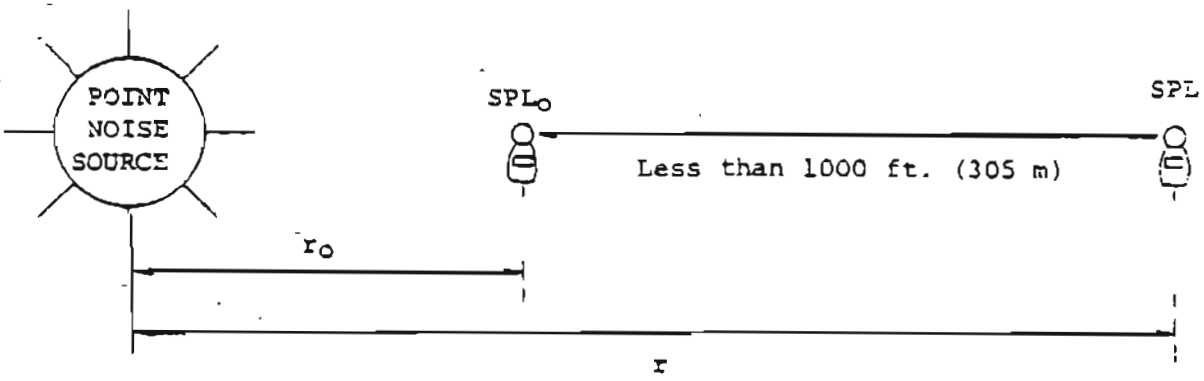
where:

SPL = sound pressure level at r feet from the source.

SPL_o = sound pressure level at r_o feet from the source. Note that r_o is a reference distance and that the distance r is always greater than r_o. The point r_o must be in the far field of the source.

Figure 4-15 illustrates a point source, such as an industrial site, and the distance at which the measurement SPL_o is taken and the distance where the required level, SPL is needed.

This projection technique is applicable only if the distance between r and r_o is less than 1000 feet. This projection technique should be used only when it is not practical to make a sound pressure level reading at r.



SOUND LEVEL ADJUSTMENT WITH DISTANCE

FIGURE 4-15

4.8.2 Line Source

Comment: The sound pressure level at a point r feet from a line source can be calculated from a sound pressure level measurement at a point r_o feet from the line source using the following equation:

$$SPL = SPL_o - 10 \log (r/r_o)$$

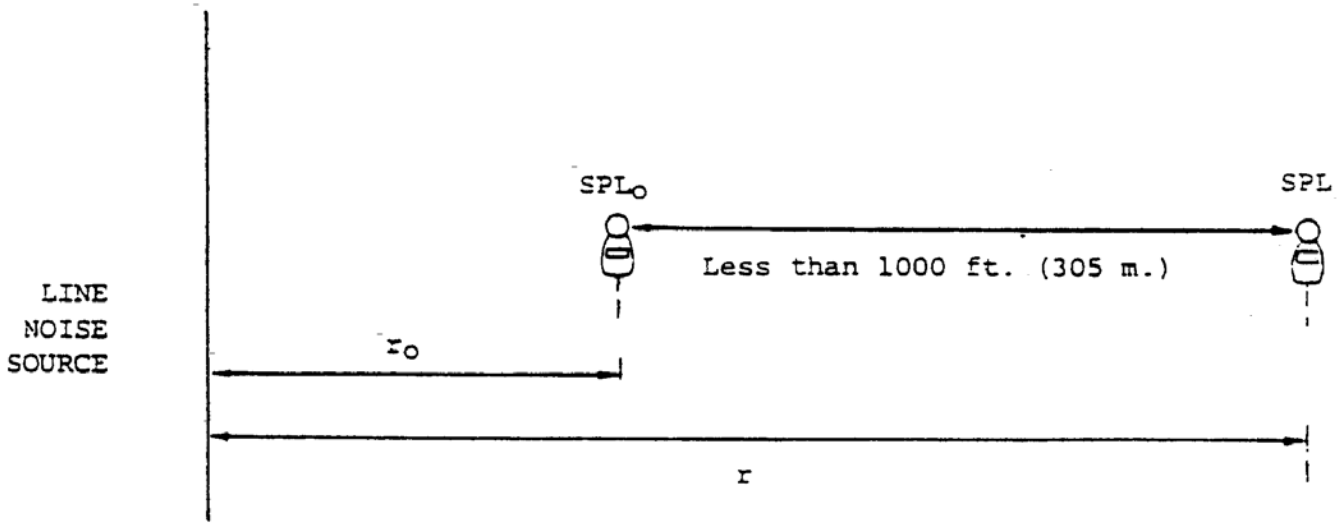
where:

SPL = sound pressure level at r feet from the source.

SPL_o = sound pressure level at r_o feet from the source. Note that r_o is a reference distance and that the distance r is always greater than r_o. The point r_o must be in the far field of the source.

Figure 4-16 illustrates a line source, such as a highway with closely spaced moving vehicles, and the distance at which the measurement, SPL_o is taken and the distance where the required level SPL is needed.

This projection technique is applicable only if the distance between r and r is less than 1000 feet. This projection technique should be used only when it is not practical to make a sound pressure level reading at point r.



LINE NOISE SOURCE DISTANCE ADJUSTMENT

FIGURE 4-16

Motor Vehicle Sound Measurement Procedures Manual

NPCS - 21

State of Oregon
Department of
Environmental
Quality

REVISION RECORD

INSTRUCTIONS FOR USE: All revisions of this manual will be numbered to assure each manual holder that he has received all revisions. The date and initials of the person inserting revisions to the manual should be entered on this revision record opposite the appropriate revision number. If the sequence is broken, copies of the missing revisions may be requested from the Noise Control Section.

Rev. No	Date Inserted	Initials	
1	7/8/74	JH	
2.	8/27/76	JH	EQC Amendments
3.	5/27/77	JH	EQC Amendments
4.	9/16/77	DO	pg. 42, corrected typographic error
5.	1/10/78	DO	pg. 12, corrected typographic error.
6.	5/21/80	JH	EQC Motorboat Amendements
7.	4/8/83	~~JH~~	EQC Amendments
8.			
9.			
10.			
11			
12.			
13.			
14.			
15.			
16			
17.			
18.			

FOREWORD

The Motor Vehicle Sound Measurement Procedures Manual has been prepared to specify the equipment to be used, and the procedures established in the manual, when carefully followed, will ensure that the noise readings obtained are accurate, will support enforcement action, and aid in reducing motor vehicle noise.

The scope of this manual includes sound measurements for new motor vehicles, on-highway motor vehicles and stationary testing of off-highway and on-highway motor vehicles.

The objective of the manual is to establish procedures to implement the objectives of the Environmental Quality Commission. Further, if the practices and procedures herein are adhered to, the result will be a uniform enforcement program which will accomplish the intent of the Legislature and fulfill the Commission's responsibility under ORS Chapter 467.

Office of the Administrator
Air Quality Control Division
Department of Environmental Quality

TABLE OF CONTENTS

Chapter 6 - NEAR

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

1.1 Policy

1.1.1 The Department of Environmental Quality, through the Noise Pollution Control Section, shall establish a noise measurement program to implement the laws and regulations applying to motor vehicle noise.

1.1.2 The Noise Pollution Control Section and cooperating enforcement agencies shall be responsible for motor vehicle noise measurement.

1.3 This manual contains procedures for the Noise Pollution Control Section, Enforcement Division, and other persons taking motor vehicle sound measurements. Guidance is provided for in the comments.

1.2 Authority

2.1 Statutory and administrative law governing authority to the guidance and direction contained in this manual is found in the following sources:

a. Oregon Revised Statutes, Chapter 467, Sections 467.010 467.020, 467.030, 467.050, 467.990.

b. Oregon Administrative Rules, Chapter 340, Division 35, Department of Environmental Quality.

1.3 Instruments and Training

1.3.1 Specific requirements for instruments and personnel are defined under procedure manual, Noise Pollution Control Section - 2, Requirements for Sound Measuring Instruments and Personnel.

1.3.2 Allied departments, divisions or agencies who select sound measuring instruments for measuring noise emissions should secure the assistance of qualified engineers in the field of sound measurement in preparing specifications and making purchases of such instruments.

1.3.3 Personnel making noise measurements shall be carefully trained in the techniques of noise measurements, use of required instruments, instrument calibration and problems which may be encountered when performing such tasks.

CHAPTER 2

STATIONARY MOTOR VEHICLE SOUND LEVEL MEASUREMENT AT 25 FEET FOR TRUCKS AND BUSES

Scope. This Chapter establishes procedures for setting up and calibrating sound measuring equipment and conducting tests to determine the sound level output of a stationary vehicle, as measured 25 feet from the vehicle. The near field test procedure at 20 inches (.5 meter) is presented in Chapter 6.

Motor vehicles in excess of 10,000 pounds GVWR or GCWR engaged in interstate commerce shall conform to measurement procedures and methodologies specified in Compliance with Interstate Motor Carrier Noise Emission Standards of the Federal Highway Administration, Department of Transportation (49 CFR 325).

These procedures, the 25-foot stationary test, are used to conduct emission tests on trucks and buses rated in excess of 8,000 pounds. The standards for these vehicles are found in Table 2 of OAR 340-35-030.

2.2 Measurement Sites. Measurement sites shall be free of sound-reflecting objects within fifty feet of the microphone and fifty feet of the vehicle to be tested. (See Figure 2-1)

Comment: A "Sound-reflecting Surface" is any object or landscape surface in the immediate vicinity of a measurement site which reflects sufficient sound to require the application of a correction factor to the sound level meter reading. Surfaces which are not sound-reflecting surfaces are:

a. Any surface that measures less than eight feet in length in a direction parallel to the portion of the microphone line on which the microphone is positioned, regardless of height (such as a telephone booth or a tree trunk) or less than one foot in height, regardless of length (such as a curb or guard rail).

b. Any vertical surface, regardless of size (such as a billboard) with the lower edge more than fifteen feet above the roadway.

c. Any uniformly smooth slanting surface with less than a forty-five degree slope above horizontal.

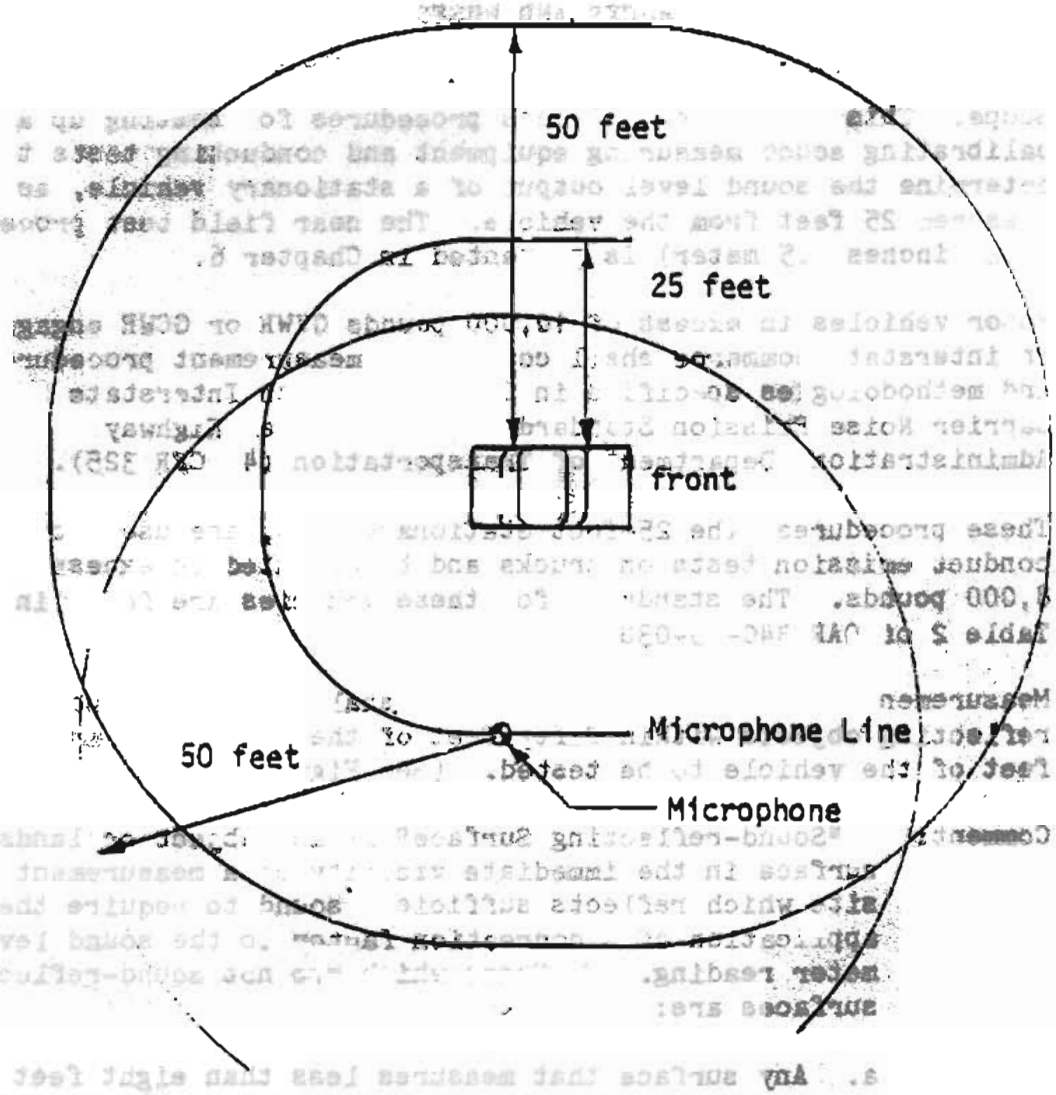


Fig. 2.1 Stationary Measurement Site

d. Any slanting surface with a forty-five to ninety degree slope above the horizontal where the line at which the slope begins to exceed forty-five degrees is more than fifteen feet above the roadway.

e. Any trees, bushes, shrubs, hedges, grass, or other vegetation.

All other surfaces are considered sound-reflecting surfaces.

2.2.1 Microphone Location. The microphone shall be located twenty-five feet ± six inches from the rear or from either side of the vehicle to be tested. The locus of points thus defined is the microphone line (See Figure 2-1). The microphone shall be located at the point on the microphone line at which the maximum sound level occurs.

Sound Level Measuring Precaution

2.3.1 Wind. Do not conduct measurements when wind velocity at the test location exceeds ten miles per hour.

2.3.2 Precipitation. Do not conduct measurements when falling precipitation affects results. However, measurements may be taken when streets are wet.

2.3.3 Ambient Noise. The ambient sound level shall be at least 10 dBA below the sound level of the vehicle being measured.

Recording. The sound level recorded shall be the highest level obtained during each test, disregarding unrelated peaks due to extraneous ambient noises.

Equipment Setup and Use.

2.4.1 General. All types of sound level meters shall be field calibrated immediately prior to use using the procedures described in the factory instruction manual.

2.4.2 Battery Check. Batteries in both the meter and calibrator shall be checked before calibration.

2.4.3 Instrument Calibration. The instrument shall be set to the correct level range, weighting scale and meter response. The calibrator shall be placed on the microphone of the meter. The output indicated on the meter shall then be adjusted to the correct calibration level.

2.4.4 Microphone Height. The sound level meter may be hand held or placed on a tripod. The microphone shall be positioned four and one-half feet above the ground.

2.4.5 Windscreens. Windscreens made of open cell polyurethane foam furnished by the instrument manufacturer shall be placed over the microphone after calibration.

COMMENT: The windscreen reduces the effect of wind noise and protects the microphone diaphragm from dust or other airborne matter.

2.4.6 Annual Calibration. Within one year prior to use, each set of sound measuring instruments, sound level meter including octave band filter, and calibrator, shall receive a laboratory calibration in accordance to the manufacturer's specifications. This calibration shall be traceable to the National Bureau of Standards.

COMMENT: An inspection label will be attached to each instrument set to determine when the calibration was performed.

2.5 Sound Level Measurement

2.5.1 Preliminary Steps. The following steps shall be followed before taking a measurement.

(a) Turn meter on.

(b) Switch meter to "A" weighting scale.

(c) Switch meter to "FAST" response.

(d) Set the meter to the appropriate range to measure the anticipated sound level.

2.5.2 Mounting. The sound level meter shall be hand held or placed on a tripod according to the manufacturer's instructions.

2.5.3 Orientation. The orientation of the sound level meter microphone shall be according to the manufacturer's instructions to obtain random incidence.

2.5.4 Variations. Allowances are necessary due to unavoidable variations in measurement sites and test equipment. Vehicles are not considered in violation unless they exceed the regulated limit by 2 dBA or more.

2.6 Vehicle Test Procedure.

2.6.1 Vehicle Sound Level. The sound levels for stationary motor vehicles shall be determined by tests performed according to the following procedures.

2.6.2 Location. The microphone shall be located on the microphone line at the position where the maximum sound level is expected to occupy. (See Figure 2-1).

2.6.3 Preliminary Tests. Sufficient preliminary tests shall be made to enable the driver to become thoroughly familiar with the test procedure.

2.6.4 Vehicle Operation. The vehicle shall be stationary, in a neutral gear, at its normal operating temperature.

a. Governed Engines. Engines with speed governors shall be run at low idle with the throttle closed. The throttle shall then be fully opened as fast as possible. As soon as the engine reaches and stabilizes at governed speed, the throttle shall be fully closed as quickly as possible.

b. Non-Governed Engines. Engines without speed governors shall be operated the same as governed engines except that the throttle shall be closed quickly enough to prevent excessive engine speed and possible damage to the engine. Drivers of vehicles supplied with tachometers should use the tachometer to monitor engine speed.

2.6.5 Visual Reading. The highest sound level observed, exclusive of peaks due to unrelated ambient noise, shall be reported for each test.

2.6.6 Reported Sound Level. The reported sound level for the vehicle shall be the highest reading which is no more than one dB higher than the next highest reading.

2.6.7 Stationary Motor Vehicle Test Form. A form to record all pertinent information and data is presented in Figure 2-2. This form, NPCS-24 or any other Department approved form for this use, shall be used for stationary tests.

STATIONARY VEHICLE NOISE TEST

NOISE POLLUTION DIVISION
DEPARTMENT OF ENVIRONMENTAL QUALITY

DATE

YEAR	VEHICLE MAKE	VEHICLE TYPE	LICENSE NO.	MODEL

REGISTERED OWNER

ADDRESS

DRIVER

D.L. NO.

ADDRESS

ENGINE TYPE	HP	ENGINE DISPLACEMENT	LOCATION	VEHICLE MILEAGE

EXHAUST OUTLET	CHECK POSITION AND SIZE OF OUTLET	RESONATORS	MUFFLER TYPE	TIRE SIZE	GEAR RATIOS
☐ Single ☐ L. Side ☐ Rear ☐ Dual ☐ R. Side ☐ Vertical	☐ Straight ☐ 45° to rear ☐ 45° to Side ☐ ___ dia	☐ Single ☐ Dual		___ x ___	Diff. ___ : ___ Spkt. ___ : ___ (No. of Teeth)

RECORDER MODEL AND DEQ NO.

METER MODEL AND DEQ NO.

CALIBRATOR AND DEQ NO.

TEST DRIVER

TEST ENGINEER

METER CHECK
☐ BAT. ☐ WINDSCREEN ☐ "A" SCALE ☐ FAST ☐ CALIB.

OPERATING CONDITIONS	Time	READINGS dBA	READINGS LOCATION NUMBER	MAX. RPM

TEST CONDITIONS

WEATHER CONDITION	TEMP.	R.H.	WIND SPEED

Sketch in this space the measurement site peculiarities, and using the proper symbols indicate the direction of wind, vehicle orientation and reading locations.

Key: WIND DIRECTION - - - →
VEHICLE ←→
MICROPHONE LOCATION NO. ⇨

INSTRUMENTATION SET UP AT 25 FT FROM EDGE OF VEHICLE

NPCS-24

Figure 2.2

Stationary Vehicle Noise Test

CHAPTER 3

IN-USE VEHICLE MOVING SOUND LEVEL MEASUREMENTS

Scope. This chapter describes the procedure for selecting sites and setting up equipment for measurement of noise from vehicles on the highway, off-road or on water.

This procedure is used to test and monitor moving vehicles at distances of 35 to 118 feet (typically 50 feet) from the vehicle path. The standards for road vehicles and off-road recreational vehicles are found in Tables 3 and 4 of OAR 340-35-030.

Measurement Sites.

3.2.1 Types of Sites. Two types are established for measuring vehicles in use on the highway. They are a standard measuring site requiring a large clear open area and a restricted measuring site in which sound-reflecting objects are permitted. When selecting measuring sites, care shall be taken to measure sites carefully and determine if a correction factor must be applied.

3.2.2 Standard Measuring Sites. Standard measuring sites are those where the microphone can be placed 50 feet from the center of the vehicle path and where there are no sound-reflecting objects within 100-foot radius of the microphone point (which is the point on the vehicle path that is closest to the microphone). (See Figure 3-1) When making measurements of vehicle sound levels in standard measuring sites, the instrument readings shall be recorded with no correction factor applied.

3.2.3 Restricted Measuring Sites. Restricted measuring sites are those where the distance from the center of the vehicle path to the microphone is other than 50 feet or where there are sound reflecting surfaces closer than 100 feet from the microphone or the microphone point. Vehicle noise measurements may be made in such areas when the proper correction factors described in this chapter are applied to the recorded sound levels. (See Figure 3-2)

3.2.4 Measuring Distance. The actual distance from the microphone to the microphone point at the center of the vehicle path may range from 35 to 118 feet when the factor obtained from Figure 3-3 is added to the sound level meter readings to correct the reading to what it would be at the standard measuring distance of 50 feet.

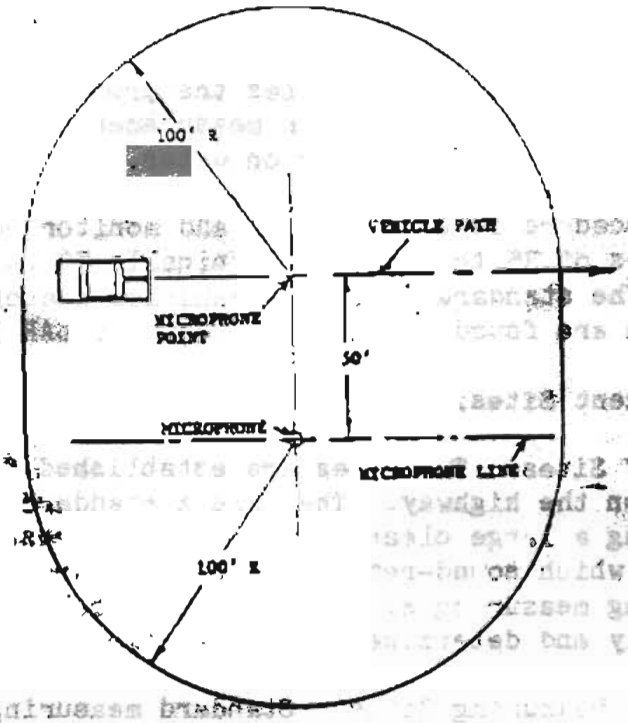


Fig. 3-1. Standard Measuring Site

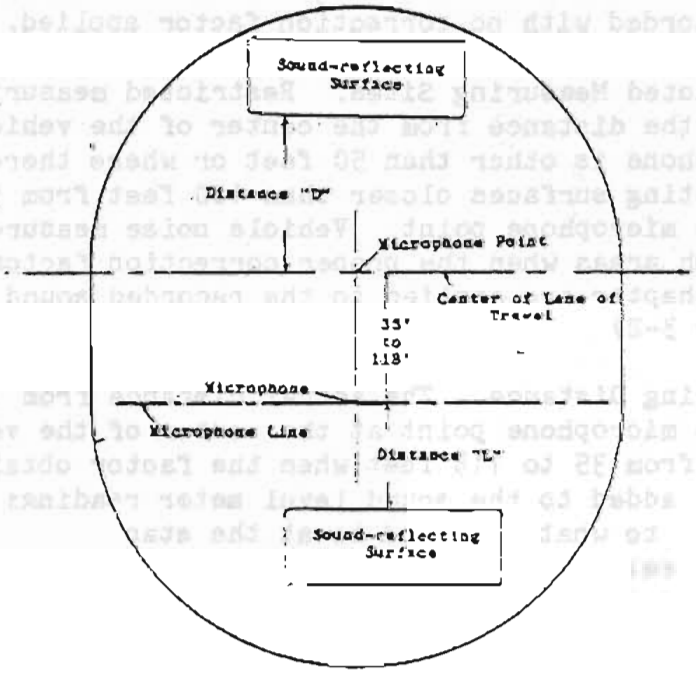


Fig. 3-2. Restricted Measuring Site

Distance from Microphone to Pathway Centerline	dBA Correction Factor
35 - 39 ft	-3
39 - 43 ft	-2
43 - 48 ft	-1
48 - 58 ft	0
58 - 70 ft	+1
70 - 83 ft	+2
83 - 99 ft	+3
99 - 118 ft	+4

Example: If the distance between the microphone and the pathway centerline is 36 feet instead of 50 feet and a vehicle is measured at 90 dBA, the recorded reading will be as follows:

90	dBA	Uncorrected reading
-3	dBA	Correction factor
87	dBA	Corrected reading

Fig 3-3 Measuring Distance Correction Factors

3.2.5 Sound-reflecting Surfaces. A "sound-reflecting surface" is any object or landscape surface in the immediate vicinity of a measurement site which reflects sufficient sound to require the application of a correction factor to the sound level meter reading.

a. Correction factors determined from paragraph 3.2.7 may be applied only when sound-reflecting surfaces are basically parallel to the lane of travel.

b. A basically parallel surface may have irregularities or projections of not more than two feet measured perpendicular to the lane of travel, with the distance to the microphone line or vehicle path measured from the closest point of the projection.

3.2.6 Surfaces Not Requiring Correction Factors. Correction factors shall not be applied to the sound level reading when the following surfaces are within the measuring area defined by paragraph 3.2.2:

a. Any surface that measures less than eight feet in length in a direction parallel to the vehicle path, regardless of height (such as telephone booth or tree trunk) or less than one foot in height, regardless of length (such as a curb or guard rail).

b. Any vertical surface, regardless of size (such as billboard) with the lower edge more than fifteen feet above the surface.

c. Any uniformly smooth slanting surface with less than a forty-five degree slope above horizontal.

d. Any slanting surface with a forty-five to ninety degree slope above horizontal where the line at which the slope begins to exceed forty-five degrees is more than fifteen feet above the surface.

e. Any trees, brushes, shrubs, hedges, grass or other vegetation.

3.2.7 Correction Factors for Sound-reflecting Surfaces. Correction factors to be applied to sound level meter readings when there are sound-reflecting surfaces within 100 feet of either the microphone or microphone point are determined as follows:

a. Reflecting Surfaces. Sites where there are sound-reflecting surfaces basically parallel to the vehicle path within the clear area of the standard site may be used by measuring the distances shown in Figure 3.4 and 3.5, and applying the correction factor obtained from the nomogram in Figure 3-6.

b. Smooth Embankments. The point of measurement from smooth embankments shall be the place on the embankment where the slope begins to exceed forty-five degrees above horizontal (See Figure 3-4). The point of measurement from irregular embankments shall be the place on the embankment where the irregularity begins. A smooth embankment is one with vegetation, concrete, asphalt, dirt or other relatively smooth cover.

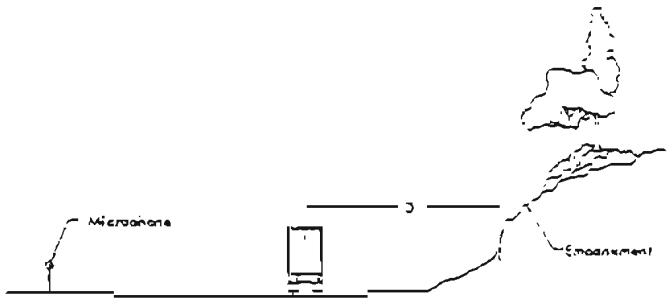


Fig. 3-4. Measurement of Distance to Embankment

c. Taking Measurements. To determine the correction factor for sound-reflecting surfaces within the measuring site, measure the distances shown in Figure 3-5. Measurement "D" is the shortest distance between the sound-reflecting surface and the centerline of the lane of travel. Measurement "L" is the shortest distance between the sound-reflecting surface and a line parallel to the lane of travel that passes through the microphone (microphone line).

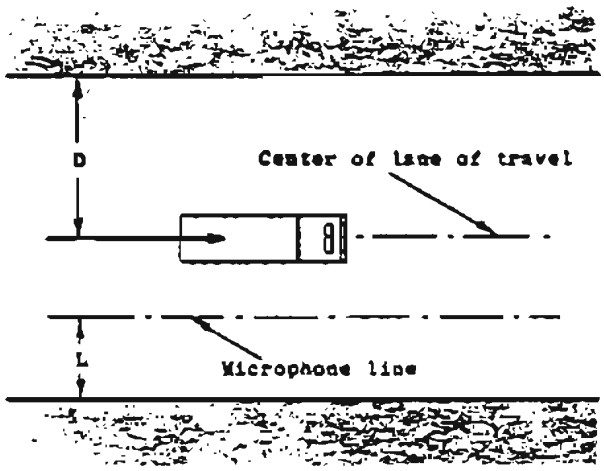
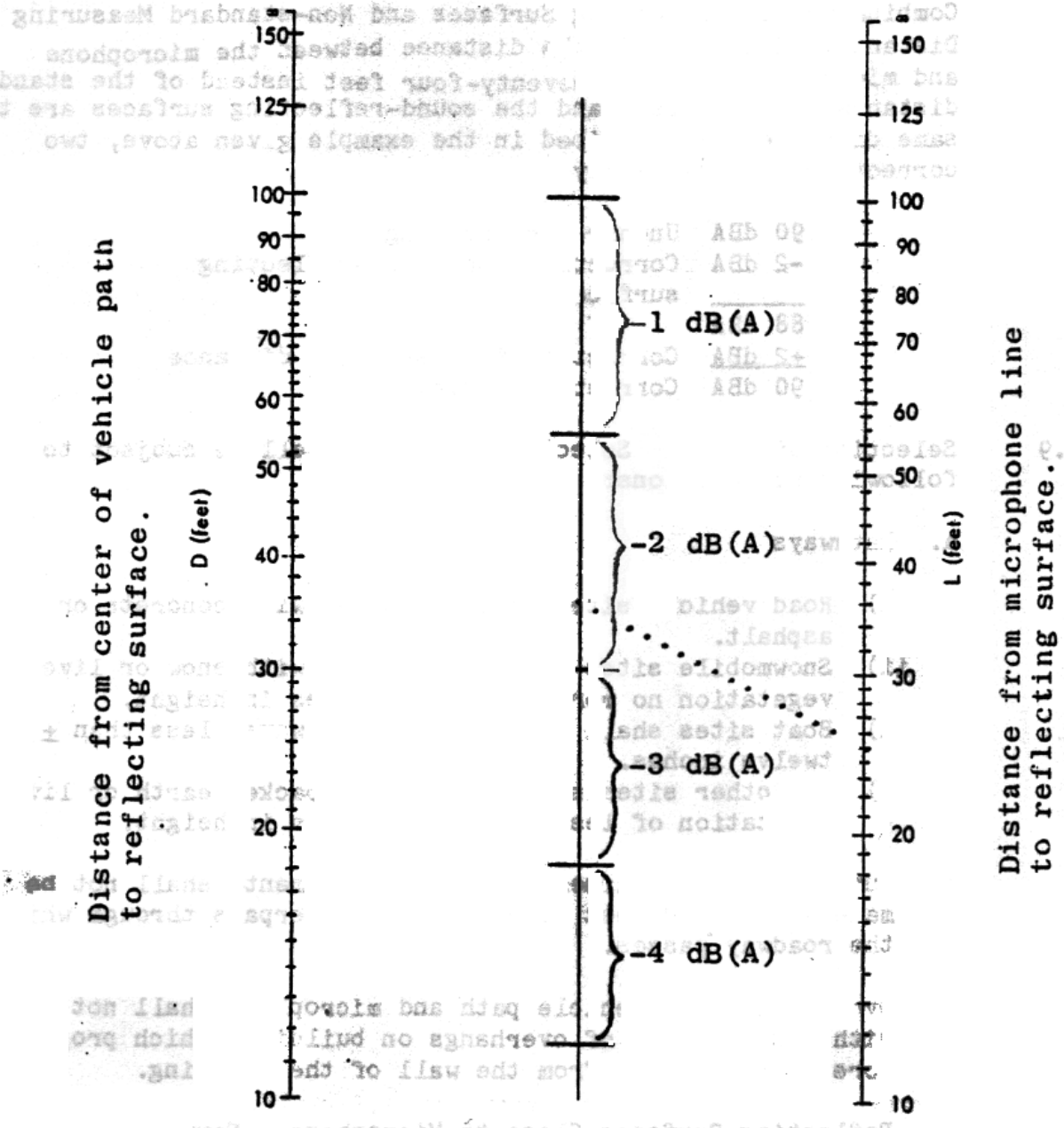


Fig. 3-5 Correction Factor Distances "D" and "L"

d. Determining Correction Factor. Locate the points on the left and right scales of the nomogram (Figure 3-6) corresponding to the distances "D" and "L." Place a straight edge across the nomogram so that it connects the two points. The point where the straight edge intersects the center axis indicates the correction factor to be applied to the sound level meter reading.

e. Example. The dotted line in Figure 3-6 illustrates the use of the nomogram for a reflecting surface fifty-two feet from the center of the lane of travel (distance "D") and one twenty-five feet from the microphone line (distance "L"). These measurements plotted on the nomogram result in a correction factor of -2 dBA. With the microphone at the standard measuring distance of fifty feet and a vehicle measured at ninety dBA, the corrected reading would be recorded as follows.

90 dBA	Uncorrected reading
-2 dBA	Correction from Figure 3-6
88 dBA	Corrected reading



On centerline read dB(A) correction to be subtracted from meter reading.

Fig. 3-6 Nomogram for Reflecting Surfaces

3.2.8 Combination of Reflecting Surfaces and Non-standard Measuring Distance. Example. If the distance between the microphone and microphone point is seventy-four feet instead of the standard distance of fifty feet and the sound-reflecting surfaces are the same distances as described in the example given above, two corrections are necessary.

90 dBA	Uncorrected reading
-2 dBA	Correction for sound-reflecting surfaces
88 dBA	
+2 dBA	Correction for measuring distance
90 dBA	Corrected reading

3.2.9 Selection of Sites. Selection of sites shall be subject to the following restrictions:

a. Pathways

i) Road vehicle sites shall be paved with concrete or asphalt.

ii) Snowmobile sites shall be covered with snow or live vegetation no more than four inches in height.

iii) Boat sites shall be on water with waves less than ± twelve inches.

iv) All other sites shall be on hard packed earth or live vegetation of less than four inches in height.

b. Tunnels and Overpasses. Sound measurements shall not be made within 100 feet of a tunnel or overpass through which the roadway passes.

c. Overhangs. The vehicle path and microphone shall not be within fifty feet of overhangs on buildings which project more than two feet from the wall of the building.

d. Reflecting Surfaces Close to Microphone. Sound reflecting surfaces, other than the ground or water, shall be no closer than ten feet from the microphone line.

e. Reflecting Surfaces Close to Lane of Travel. Sound reflecting surfaces shall be no closer than ten feet from the center of the lane of travel for a distance of 100 feet parallel to the vehicle path on either side of the microphone point.

f. Non-parallel Reflecting Surfaces. Large reflecting surfaces that are not basically parallel to the lane of travel shall be 100 feet or more from the microphone or microphone point. (see Figure 3-7).

g. Grades. The standards for road vehicles on "level roadways" contained in Table 3 of OAR 340-35-030 may be applied to vehicles traveling on any roadway that does not exceed a grade of plus two (2) percent.

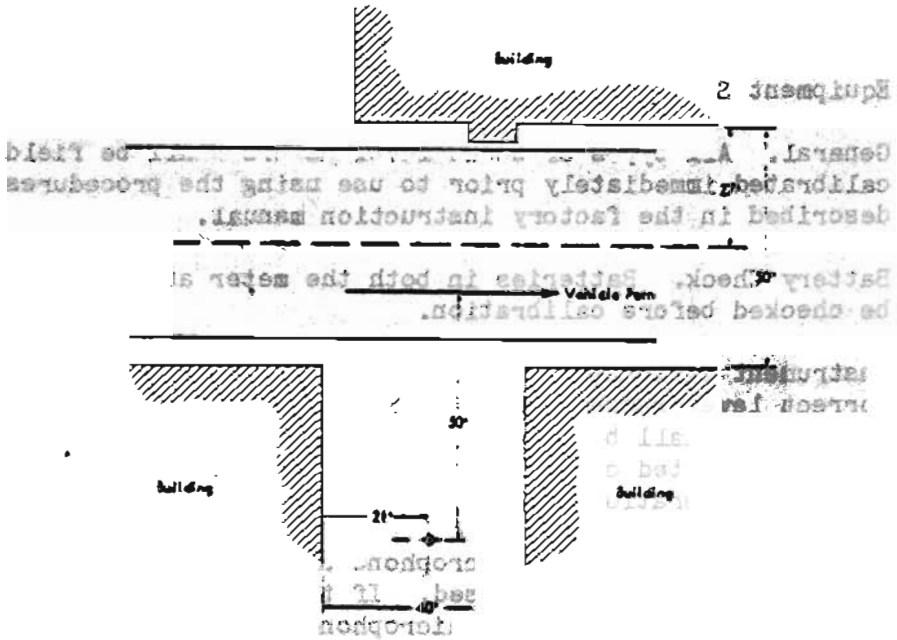


Fig. 3.7. Unacceptable Measuring Site

3.3 Sound Level Measuring Precautions

3.3.1 Identification. It is most important that the noise recorded is actually from the vehicle being measured. Care must be taken to ensure that noise from another vehicle does not add to that from the one being measured.

3.3.2 Intensity. The sound level of the vehicle under scrutiny must rise at least 6 dBA before and fall at least 6 dBA after the maximum sound level occurs.

3.3.3 Recording. The sound level recorded shall be the highest level obtained as the vehicle passes by, disregarding unrelated peaks due to extraneous ambient noises.

3.3.4 Wind. Always use the wind screen on the microphone when taking measurements. Do not conduct measurements when wind velocity at the test location exceeds ten miles per hour.

3.3.5 Precipitation. Do not conduct measurements when falling precipitation affects results. Streets shall be dry during road vehicle measurements.

Ambient Noise. The ambient sound level shall be at least 10 dBA below the sound level of the vehicle being measured.

3.4 Equipment Setup and Use

3.4.1 General. All types of sound level meters shall be field calibrated immediately prior to use using the procedures described in the factory instruction manual.

Battery Check. Batteries in both the meter and calibrator shall be checked before calibration.

3.4.3 Instrument Calibration. The instrument shall be set to the correct level range, weighting scale and meter response. The calibrator shall be placed on the microphone of the meter. The output indicated on the meter shall then be adjusted to the correct calibration level.

Microphone Height. The microphone shall be placed on a tripod if an extension cable is used. If the cable is not used, the sound level meter with the microphone attached may be hand held or placed on a tripod. The microphone shall be positioned at height of 4 $\pm$ 1/2 ft as shown in Figure 3.8.

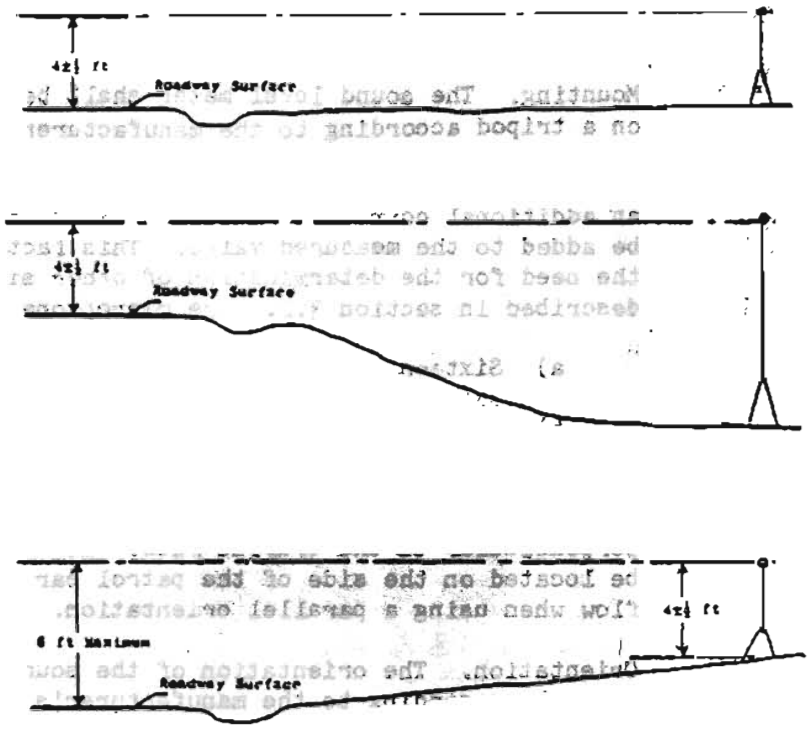


Fig. 3-8. Microphone Height

3.4.5 Windscreens. Windscreens made of open cell polyurethane foam furnished by the instrument manufacturer shall be placed over the microphone after calibration.

3.4.6 Annual Calibration. Within one year prior to use, each set of sound measuring instruments, sound level meter including octave band filter, and calibrator, shall receive a laboratory calibration in accordance to the manufacturer's specifications. This calibration shall be traceable to the National Bureau of Standards.

COMMENT: An inspection label will be attached to each instrument set to determine when the calibration was performed.

3.5 Sound Level Measurement

3.5.1 Preliminary Steps. The following steps shall be followed before taking a measurement.

a) Turn meter on.

b) Switch meter to "A" weighting scale.

c) Switch meter to "FAST" response.

d) Set the meter to the appropriate range to measure the anticipated sound level.

3.5.2 Mounting. The sound level meter shall be hand held or placed on a tripod according to the manufacturer's instructions.

The meter microphone may also be mounted above a patrol car with an additional correction factor of minus two decibels (-2 dBA) to be added to the measured value. This factor does not preclude the need for the determination of other site correction factors described in section 3.2. The microphone shall be mounted:

a) Sixteen (16) to twenty-four inches above the plane of the car roof, and
b) Not fore of the roof-windshield line nor aft of the roof-rear window line.

The patrol vehicle may be orientated either parallel or perpendicular to the traffic flow. However, the microphone shall be located on the side of the patrol car closest to the traffic flow when using a parallel orientation.

3.5.3 Orientation. The orientation of the sound level meter microphone shall be according to the manufacturer's instructions to obtain random incidence.

3.5.4 Variations. Allowances are necessary due to unavoidable variations in measurements sites and test equipment. Vehicles are not considered in violation unless they exceed the regulated limit by 2 dBA or more.

3.6 Vehicle Test Procedures

The moving vehicle test can be made after the following steps are accomplished.

a) The test site is selected and correction factors are determined as defined in Section 3.2.

b) The necessary measuring precautions are taken as described in Section 3.3.

c) The test equipment is setup as described in Section 3.4.

A form to record all pertinent information and data is presented in Figure 3-9. This form, NPCS-25, or any other Department approved form for this use shall be used for the moving vehicle noise tests.

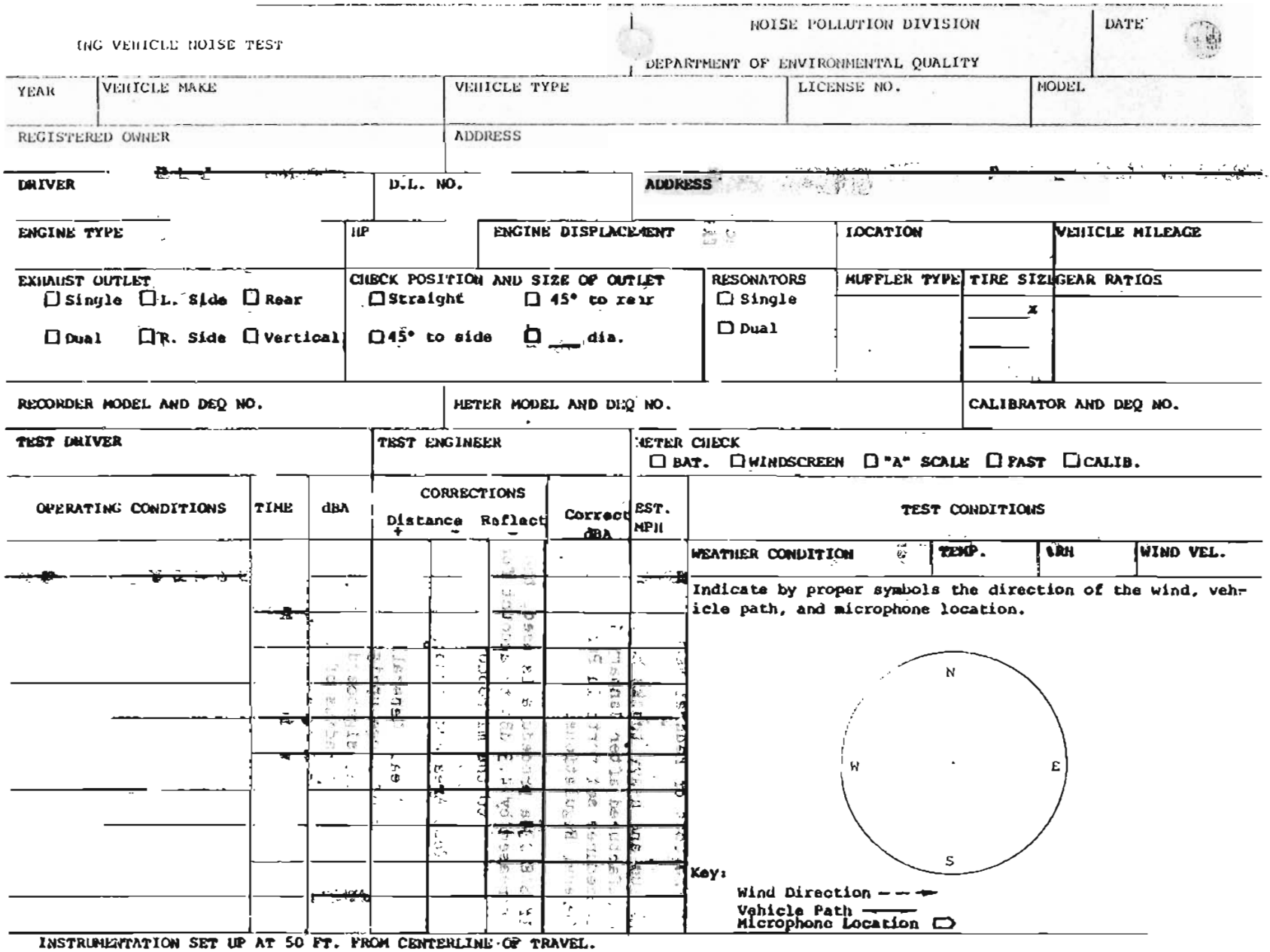


Figure 3-9

Moving Motor Vehicle Test

CHAPTER 4

NEW VEHICLE SOUND LEVEL MEASUREMENT

4.1 Scope. This Chapter establishes procedures for setting up and calibrating sound measuring equipment and conducting tests to determine vehicle sound level output.

OAR 340-35-025 requires all new motor vehicles offered for sale be certified as meeting noise emission limits specified in Table 1. Standards are established for new motorcycles, snowmobiles, automobiles, trucks, buses and motorboats. Emission test procedures for each of these categories are described in this chapter. In lieu of the procedures of this chapter, the following procedures adopted by the Society of Automotive Engineers (SAE) have also been approved:

Motorcycles	SAE J331a*
Snowmobiles	SAE J192a
Autos & Light Trucks	SAE J986NOV 81
Trucks and Buses	SAE J366b**
Motorboats	SAE J34***

Revised 4-1-88

* Motorcycles manufactured after December 31, 1982 shall be tested in accordance with procedures set forth in Part 205 Subpart D of Title 40 of the Code of Federal Regulations.

** Medium and heavy trucks having a GVWR in excess of 10,000 pounds and manufactured after January 1, 1978 shall be tested in accordance with procedures set forth in Part 205 Subpart B of Title 40 of the Code of Federal Regulations.

*** If SAE J34a procedure is used, the resulting emission levels shall be increased by 4.3 dBA to account for the increased distance from the motorboat to the microphone.

4.2 Test Area and Personnel.

4.2.1 Test Area. Generally, the test area shall be a flat open space free of large upright sound reflecting surfaces, such as parked vehicles, signboards, building, or hillsides, located within 100 feet radius of the microphone as shown in Figure 4-1. Detailed test area layouts are provided in Section 4.5 for specific vehicle categories.

4.2.2 Surface Condition. The surface of the ground within the measuring site for road vehicles shall be smooth asphalt or concrete free of snow, soil or ashes in at least the triangular area formed by the microphone location and points on the vehicle path 50 feet before and beyond the microphone point. The ground surface in the above area for snowmobiles shall be live

vegetation (grass) no more than four inches in height. Motorboats shall be tested on a calm water surface.

4.2.3 Roadway Surface. The surface of the vehicle path shall be dry, smooth asphalt or concrete pavement free of extraneous material, except that the pathway for snowmobiles shall be covered with live vegetation (grass) no more than four inches in height or a maximum of three inches of loose snow over a base of at least two inches of compacted snow.

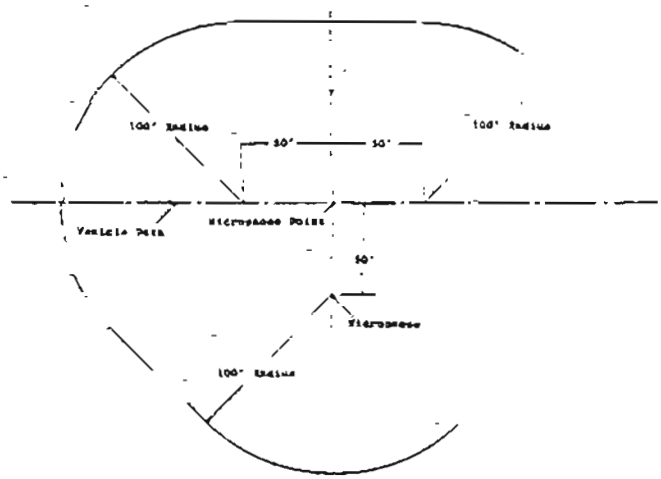


Fig. 4-1. New Vehicle Test Area Layout

4.2.4 Wind. Do not conduct sound measurements when wind velocity at the test area exceeds ten miles per hour.

4.2.5 Personnel Location. Excercise care to prevent interference with sound level measurements caused by personnel in the measuring area.

a. Bystander Location. Bystanders shall remain at least fifty feet from the microphone and the vehicle being measured during sound level measurements.

b. Technician Location. The technician making direct readings from the sound level meter with microphone attached shall stand with the instrument positioned in accordance with the manufacturer's instructions.

Equipment Setup and Use.

General. All types of sound level meters shall be field calibrated immediately prior to use using the procedures described in the factory instruction manual.

4.3.2 Battery Check. Batteries in both the meter and calibrator shall be checked before calibration.

Instrument Calibration. The instrument shall be set to the correct level range, weighting scale, and meter response. The calibrator shall be placed on the microphone of the meter. The output indicated on the meter shall then be adjusted to the correct calibration level.

4.3.4 Microphone Location. Attach the microphone or sound level meter to the tripod, extending the tripod legs so that the microphone, when aimed at the microphone point, will be at a height of 4 ± 1/2 ft. above the plane of the roadway or water surface. Position the tripod so the microphone is at a distance of 50 ± 1 ft. from the center of the lane of travel.

COMMENT: Connect extension cable between the instruments. Secure the cable to the foot of the tripod leg nearest the recorder location. This will help prevent the tripod from being pulled over by an accidental tug on the cable.

4.3.5 Windscreens. Windscreens made of open cell polyurethane foam furnished by the instrument manufacturer shall be placed over the microphone after calibration.

COMMENT: The windscreen reduces the effect of wind noise and protects the microphone diaphragm from dust or other airborne matter.

Annual Calibration. Within one year prior to use, each set of sound measuring instruments, sound level meter including octave band filter, and calibrator, shall receive a laboratory calibration in accordance to the manufacturer's specifications. This calibration shall be traceable to the National Bureau of Standards.

COMMENT: An inspection label will be attached to each instrument set to determine when the calibration was performed.

Sound Level Measurement

Preliminary Steps. The following steps shall be followed before taking a measurement.

a) Turn meter on.

b) Switch meter to "A" weighting scale.

c) Switch meter to "FAST" response.

d) Set the meter to the appropriate range to measure the anticipated sound level.

4.4.2 Mounting. The sound level meter shall be placed on a tripod according to the manufacturer's instructions.

4.4.3 Orientation. The orientation of the sound level meter microphone shall be according to the manufacturer's instructions !to obtain random incidence1.

4.4.4 Variations. Allowances are necessary due to unavoidable variations in measurement sites and test equipment. Vehicles are not considered in violation unless they exceed the regulated limit by 2 dBA or more.

4.4.5 Weather Measurement. Record wind velocity and direction with a wind gauge, and temperature and relative humidity with a sling psychrometer or other Department approved instruments.

4.4.6 Data Recording. Record all required vehicle data, type of test equipment, and weather information on the New Vehicle Test Form, (NPCS-26), as shown in Figure 4-2 or any other form approved in writing by the Department.

4.5 New Vehicle Test Procedure

4.5.1 Vehicle Sound Level. The sound levels for new motor vehicles shall be determined by tests performed according to procedures established for each particular class of vehicle.

4.5.2 Definitions. For the purpose of these procedures, the following terms have the meanings indicated:

a. Maximum RPM. "Maximum rpm" means the maximum governed engine speed, or if ungoverned, the rpm at maximum engine horsepower as determined by the engine manufacturer in accordance with the procedures in Society of Automotive Engineers Standard, Engine Power Test Code - Spark Ignition and Diesel - SAE J1349 DEC 80.

b. Microphone Point. "Microphone point" means the unmarked location on the center of the lane of travel that is closest to the microphone.

c. Vehicle Reference Point. "Vehicle reference point" means the location of the vehicle used to determine when the vehicle is at any of the points on the vehicle path. The primary vehicle reference point is the front of the vehicle.

NEW VEHICLE NOISE TEST

DEPARTMENT OF ENVIRONMENTAL QUALITY

DATE

YEAR	VEHICLE MAKE	VEHICLE TYPE	LICENSE NO.	MODEL
REGISTERED OWNER		ADDRESS		
DRIVER	D.L. NO.	ADDRESS		
ENGINE TYPE	HP	ENGINE DISPLACEMENT	LOCATION	VEHICLE MILEAGE

EXHAUST OUTLET
☐ Single ☐ L. Side ☐ Rear
☐ Dual ☐ R. Side ☐ Vertical

CHECK POSITION AND SIZE OF OUTLET
☐ Straight ☐ 45° to rear
☐ 45° to side ☐ dia.

RESONATORS
☐ Single
☐ Dual

MUFFLER TYPE

TIRE SIZE

Diff. ____ : ____
Sprkt. ____ : ____
(No. of Teeth)

RECORDER MODEL AND DEQ NO.	METER MODEL AND DEQ NO.	VEHICLE SUPPLIED BY	CALIBRATOR AND DEQ NO.

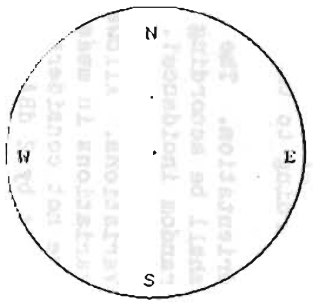
TEST DRIVER	TEST ENGINEER	METER CHECK
		☐ BAT. ☐ WINDSCREEN ☐ "A" SCALE ☐ FAST ☐ CALIB.

OPERATING CONDITIONS	TIME	dBA READINGS L.S.	dBA READINGS R.S.	MAXIMUM RPM	MAXIMUM MPH

TEST CONDITIONS

WEATHER CONDITION	TEMP.	%RH	WIND VEL.

Indicate by proper symbols the direction of the wind, vehicle path, and microphone location.



Key:
Wind Direction
Vehicle Path
Microphone Location

INSTRUMENTATION SET UP AT 50 FT. FROM CENTERLINE OF TRAVEL.

NPCS-26

Figure 4-2
New Vehicle Test

4.5.3 Operation

a. Preliminary Runs. Sufficient preliminary runs shall be made to enable the test driver to become familiar with the operation of the vehicle and to stabilize engine operating conditions.

b. Test Runs. At least four test runs shall be made for each side of the vehicle.

c. Reported Noise Level. The reported sound level for each side of the vehicle shall be on the average of the two highest readings on that side which are within 2 dBA of each other. The sound level reported for the vehicle shall be the sound level of the loudest side.

d. Visual Reading and Recording. Visual readings shall be taken from the sound level meter during preliminary test runs and recorded. The readings from the sound level meter shall be compared with those of the recorder and there shall be no more than $\pm$ 0.5 dBA variation between the readings. When the variation is greater, the equipment shall be checked and recalibrated. If the variation still exists, the test shall be conducted using only direct readings from the sound level meter.

4.5.4 Motorcycles. Motorcycles shall be tested as follows:

a. Vehicle Path. The test area shall include a vehicle path of sufficient length for safe acceleration, deceleration, and stopping of the vehicle.

b. Test Area Layout. The following points and zones shown in Figure 4-3 where only one directional approach is illustrated for purposes of clarity, shall be established on the vehicle path so that measurements can be made on both sides of the vehicle:

1. Microphone point.

2. Acceleration point - a location 25 feet before the microphone point.

3. End point - a location 100 feet beyond the microphone point.

4. End zone - the last 75-feet distance between the microphone point and the end point.

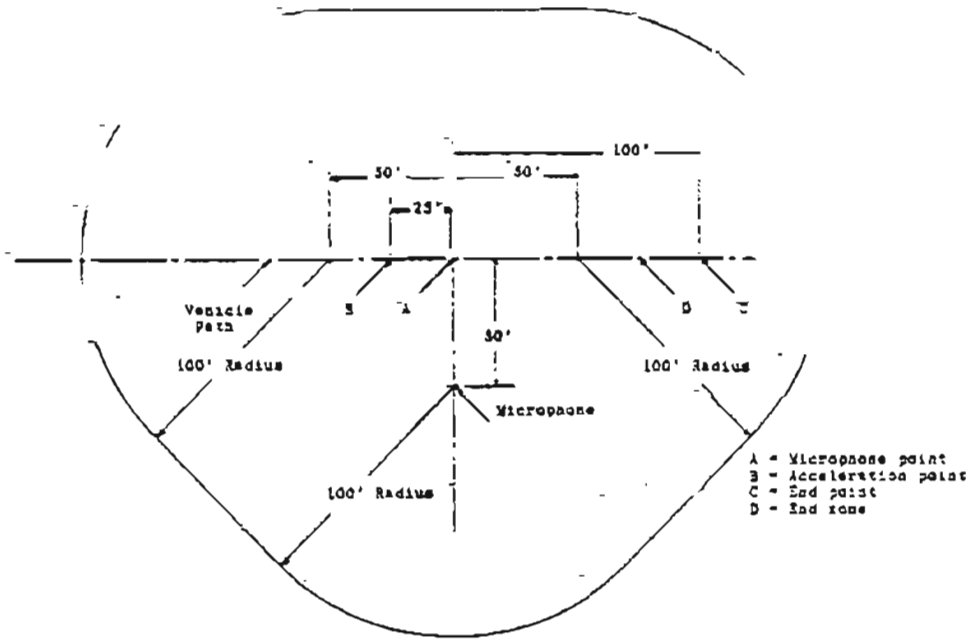


Fig. 4-3. Test Area Layout for Motorcycles

c. Test Procedures. Vehicles shall be tested according to the following procedures:

1. Gear Selection. Motorcycles shall be operated in second gear. Vehicles which reach maximum rpm at less than 30 mph or before a point of 25 feet beyond the microphone point shall be operated in the next higher gear.

If the motorcycle has an automatic transmission or torque converter, then gear selection shall follow the following procedure:

If the gear range is selectable, employ the lowest range. If the vehicle reaches maximum rpm at less than 30 mph or before a point 25 feet beyond the microphone point (see Figure 4-3), use the next higher range. If maximum rpm is reached before a point 25 feet beyond the microphone point when the vehicle is in the highest gear range, then the throttle shall be opened less rapidly, but in such a manner that full throttle and maximum rpm are attained while within the end zone.

If the gear range is not selectable, then the throttle shall be opened less rapidly, but in such a manner that full throttle and maximum rpm are attained while within the end zone.

2. Acceleration. The vehicle shall proceed along the test path at a constant approach speed which corresponds either to an engine speed of 60 percent of maximum rpm or to 30 mph, whichever is lower. When the vehicle reference point reaches the acceleration point, the throttle shall be rapidly and fully opened. The throttle shall be held open until the vehicle reference point reaches the end point or until the maximum rpm is reached within the end zone, at which point the throttle shall be closed. Wheel slip shall be avoided.

3. Deceleration. Tests during deceleration shall be conducted when deceleration noise appears excessive. The vehicle shall proceed along the vehicle path at maximum rpm in the same gear selected for the tests during acceleration. When the reference point on the vehicle reaches the acceleration point, the throttle shall be rapidly closed and the vehicle shall be allowed to decelerate to less than 1/2 of maximum rpm.

4. Engine Temperature. The engine temperature shall be within normal operating range before each test run.

5. Test Weight. The total weight of test driver and test instrumentation shall be 165 lbs. For small drivers, additional weights shall be used to bring the total to 165 lbs.

6. 1983 and Subsequent Models. These models shall be tested in accordance with U.S. EPA procedures. See paragraph 4.1 of this Chapter.

4.5.5 Snowmobiles. Snowmobiles shall be tested as follows:

a. Vehicle Path. The test area shall include a vehicle path of sufficient length for safe acceleration, deceleration, and stopping of the vehicle.

b. Test Area Layout. The following points and zones shown in Figure 4-3, where only one directional approach is illustrated for the purposes of clarity, shall be established on the vehicle path so that measurements can be made on both sides of the vehicle.

1 Microphone point.

2. End point - a location 50 feet beyond the microphone point.

3. Acceleration point - a location on the vehicle path established as follows: Position the vehicle headed

away from the microphone point with the vehicle reference point at 25 feet from the microphone point. From a standing start with transmission in low gear, rapidly apply wide-open throttle, accelerating until maximum rpm is attained. The location on the vehicle path where maximum rpm was attained is the acceleration point for test run in the opposite direction.

4. Maximum rpm zone.

c. Test Procedures. From a standing start, with transmission in low gear and the vehicle reference point positioned at the acceleration point, the throttle shall be rapidly and fully opened and held through the maximum rpm zone until the reference point on the vehicle reaches the end point after which the throttle shall be closed.

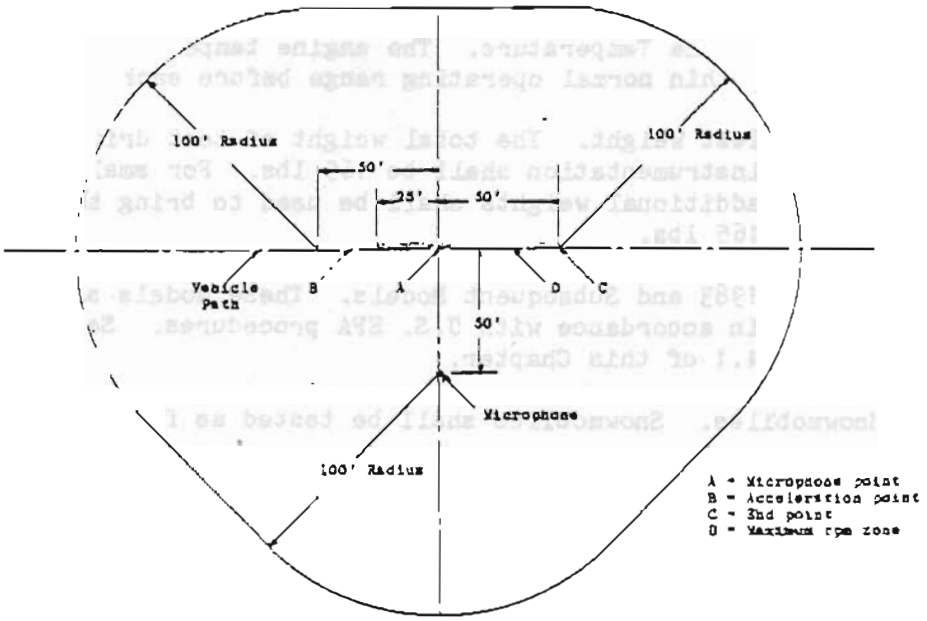


Fig 4-4. Test Area Layout for Snowmobiles

4.5.6 Heavy Trucks, Truck Tractors, and Buses. The test procedure for vehicles with a manufacturer's gross vehicle weight rating of 10,000 lbs or more shall be as follows:

(1) Test Area Layout. The test area shall include a vehicle path of sufficient length for safe acceleration, deceleration, and stopping of the vehicle. The following points and zones shall be established on the vehicle path

as shown in Figure 4-5, where only one directional approach is illustrated for purposes of clarity.

(A) Microphone point.

(B) Acceleration point - a location 50 ft before the microphone point.

(C) End point - a location 50 ft beyond the microphone point.

(D) End zone - the last 40-ft distance between the microphone point and the end point.

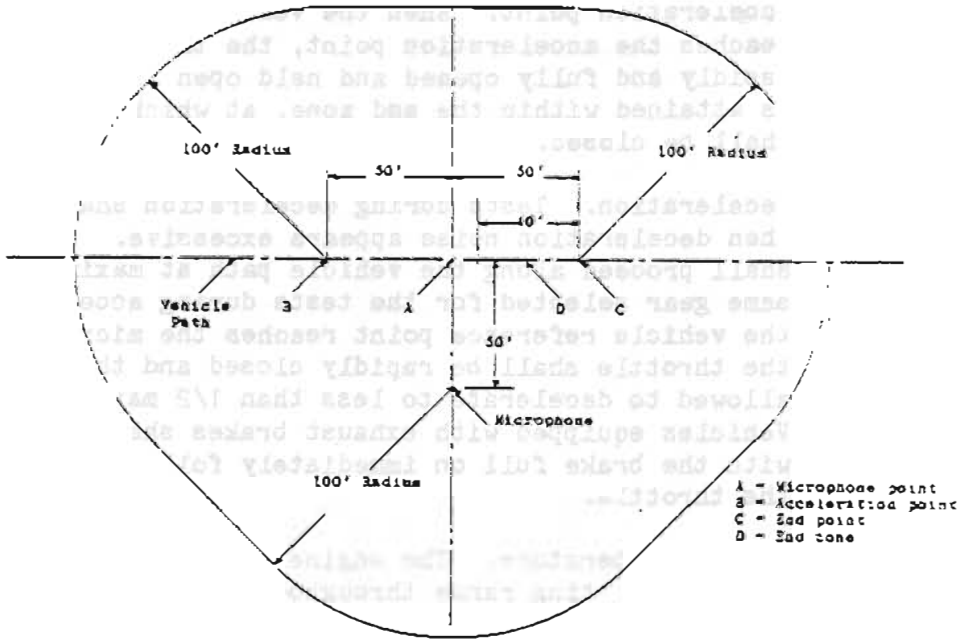


Figure 4-5. Test Area Layout for Trucks.

(2) Gear Selection. A gear shall be selected (manual or automatic transmission) which will result in the vehicle beginning at an approach rpm of no more than 2/3 maximum rpm at the acceleration point and reaching maximum rpm within the end zone without exceeding 35 mph.

(A) When maximum rpm is attained before reaching the end zone, the next higher gear shall be selected, up to the gear where maximum rpm produces over 35 mph.

(B) When maximum rpm still occurs before reaching the end zone, the approach rpm shall be decreased in 100 rpm

increments until maximum rpm is attained within the end zone.

(C) When maximum rpm is not attained until beyond the end zone, the next lower gear shall be selected until maximum rpm is attained within the end zone.

(D) When the lowest gear still results in reaching maximum rpm beyond the end zone, the approach rpm shall be increased in 100 rpm increments above 2/3 maximum rpm until the maximum rpm is reached within the end zone.

(3) Acceleration. The vehicle shall proceed along the vehicle path maintaining the approach engine rpm in the gear selected for at least 50 ft before reaching the acceleration point. When the vehicle reference point reaches the acceleration point, the throttle shall be rapidly and fully opened and held open until maximum rpm is attained within the end zone, at which point the throttle shall be closed.

(4) Deceleration. Tests during deceleration shall be conducted when deceleration noise appears excessive. The vehicle shall proceed along the vehicle path at maximum rpm in the same gear selected for the tests during acceleration. When the vehicle reference point reaches the microphone point, the throttle shall be rapidly closed and the vehicle allowed to decelerate to less than 1/2 maximum rpm. Vehicles equipped with exhaust brakes shall also be tested with the brake full on immediately following closing of the throttle.

(5) Engine Temperature. The engine temperature shall be within normal operating range throughout each test run.

(6) Demand-Activated Fans. If the test vehicle contains a demand-activated fan, the fan may be in the "off" position during the test.

(7) 1978 and Subsequent Model Trucks. These models shall be tested in accordance with U.S. EPA procedures. See paragraph 4.1 of this Chapter.

4.5.7 Automobiles, Light Trucks, Truck Tractors, Buses, and All Other Vehicles. The test procedure for trucks, truck tractors, and buses with a manufacturer's gross vehicle weight rating of less than 10,000 lbs and all passenger cars shall be as follows:

1) Test Area Layout. The test area shall include a vehicle path of sufficient length for safe acceleration, deceleration, and stopping of the vehicle. The following

points and zones shall be established on the vehicle path as shown in Figure 4-6, where only one directional approach is illustrated for purposes of clarity:

Microphone point.

(B) Acceleration point - a location 25 ft before the microphone point.

End point - a location 100 ft beyond the microphone point.

End zone - the last 75-ft distance between the microphone point and the end point.

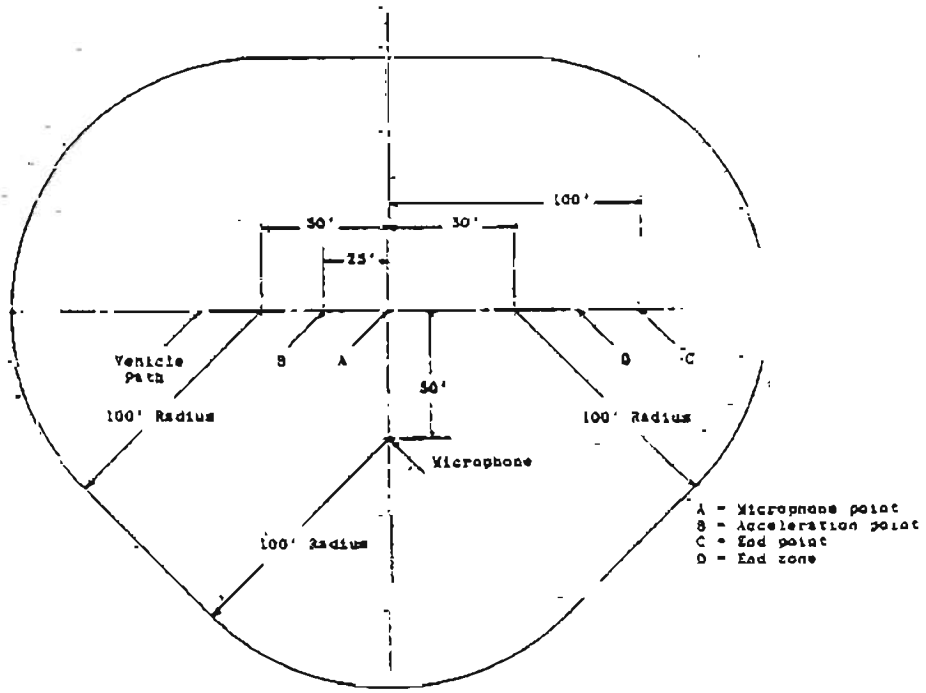


Figure 4-6. Test Area Layout for Passenger Cars

(2) Gear Selection. Motor vehicles equipped with three-speed manual transmissions and with automatic transmissions shall be operated in first gear. Vehicles equipped with manual transmissions of four or more speeds shall be operated in first gear and in second gear. Vehicles which reach maximum rpm at less than 30 mph or before reaching the end zone shall be operated in the next higher gear. Auxiliary step-up ratios (overdrive) shall not be engaged on vehicles so equipped.

Acceleration. The vehicle shall proceed along the vehicle path at a constant speed of 30 mph in the selected gear for at least 50 ft before reaching the acceleration point. When the vehicle reference point reaches the acceleration point, the throttle shall be rapidly and fully opened. The throttle shall be held open until the vehicle reference point reaches the end point or until maximum rpm is reached within the end zone. At maximum rpm, the throttle shall be closed sufficiently to keep the engine just under maximum rpm until the end point, at which time the throttle shall be closed.

(4) Deceleration. Tests during deceleration shall be conducted when deceleration noise appears excessive. The vehicle shall proceed along the vehicle path at a stabilized engine speed (rpm) the same as the maximum engine speed attained during the acceleration test and in the same gear. This approach speed is rated engine speed, if attained in the acceleration test mode, or the average of the terminal engine speed values at the end of the end zone as determined from the acceleration test. When the front of the vehicle reaches the acceleration point, the throttle shall rapidly be closed and the vehicle allowed to decelerate to one-half the approach speed or until the front of the vehicle reaches the end of the end zone.

(5) Engine Temperature. The engine temperature shall be within normal operating range throughout each test run. The engine shall be idled in neutral for at least one minute between runs.

4.5.8 Motorboats. The test procedure for motorized water craft (motorboats) shall be as follows:

Test Area Layout. A suitable test site is a calm body of water, large enough to allow full-speed pass-bys. The area around the microphone and boat shall be free of large obstructions, such as buildings, boats, hills, large piers, breakwater, etc., for a minimum distance of 100 ft. (30 m). Three markers (buoys or posts) will be placed in line, 50 ft. (15 m) apart, to mark the course the boat is to follow while being tested.

(2) Test Procedure. The boat shall pass all three markers on a straight course at wide-open throttle with the engine operating at the midpoint of the manufacturer's recommended full-throttle rpm range. The engine speed tolerance shall be $\pm$ 100 rpm if this falls in the recommended full-throttle

speed range. If a single top speed rpm is recommended, the tolerance shall be +0, -100 rpm.

(3) Measurements. The microphone shall be placed 50 ft (15 m) from the line determined by the three markers, normal to the line and opposite the center marker. It will also be placed 3 1/2 - 4 1/2 ft (1.1 - 1.4 m) above the water surface, and no closer than 2 ft (0.6 m) from the surface of the dock or platform on which the microphone stands, as near to the end of the dock as possible or overhanging the end of the dock. Measurements shall be taken while the boat is passing no more than three (3) feet (0.9 m) on the far side of all three markers.

CHAPTER 5

AUXILIARY EQUIPMENT SOUND LEVEL MEASUREMENT

5.1 Scope. This Chapter establishes procedures for setting up and calibrating sound measuring equipment and conducting tests to determine the sound level output of auxiliary motor vehicle equipment.

5.2 Measurement Sites. Measurement sites shall be free of sound-reflecting objects within one-hundred feet of the microphone and one-hundred feet of the vehicle to be tested.

5.2.1 Microphone Location. The microphone shall be located fifty feet ± six inches from the rear or from either side of the equipment to be tested. The locus of points thus defined is the microphone line. (See Figure 5-1) The microphone should be located at the point on the microphone line at which the maximum sound level occurs.

5.2.2 Sound-reflecting Surfaces. A "sound-reflecting surface" is any object or landscape surface in the immediate vicinity of a measurement site which reflects sufficient sound to require the application of a correction factor to the sound level meter reading. Surfaces which are not sound-reflecting surfaces are defined in paragraph 5.2.3, and all other surfaces are considered sound-reflecting surfaces.

5.2.3 Surfaces Which are not Sound-reflecting. The following surfaces may be present in the test area:

a. Any surface that measures less than eight feet in length in a direction parallel to the portion of the microphone line on which the microphone is positioned, regardless of height (such as a telephone booth or a tree trunk) or less than one foot in height, regardless of length (such as a curb or guard rail).

b. Any vertical surface, regardless of size (such as a billboard with the lower edge more than fifteen feet above the roadway).

c. Any uniformly smooth slanting surface with less than a forty-five degree slope above horizontal.

d. Any slanting surface with a forty-five to ninety degree slope above the horizontal where the line at which the slope begins to exceed forty-five degrees is more than fifteen feet above the roadway.

e. Any trees, bushes, shrubs, hedges, grass or other vegetation.

5.3 Sound Level Measuring Precaution

5.3.1 Wind. Do not conduct measurements when wind velocity at the test location exceeds ten miles per hour.

5.3.2 Precipitation. Do not conduct measurements when falling precipitation affects results. However, measurements may be taken when streets are wet.

5.3.3 Ambient Noise. The ambient sound level shall be at least 10 dBA below the sound level of the equipment being measured.

5.3.4 Recording. The sound level recorded shall be the highest level obtained during each test, disregarding unrelated peaks due to extraneous ambient noises.

Equipment Setup and Use

5.4.1 Microphone Height. The sound level meter may be hand held or placed on a tripod. The microphone shall be positioned four and one-half feet above the ground.

5.4.2 Windscreens. Windscreens made of open cell polyurethane foam furnished by the instrument manufacturer may be placed over the microphone after calibration. The windscreen reduces the effect of wind noise and protects the microphone diaphragm from dust or other airborne matter.

5.4.3 Sound Level Meter Setup and Use. Procedures for setup, calibration and use of the sound level meter is contained in this section.

a) General. All types of sound level meters shall be calibrated using the procedures described in the factory instruction manual. All instruments shall be calibrated prior to use. A general discussion of calibration procedures follows.

b) Battery Check. The state of the battery shall be checked before the calibration of the instrument. Batteries in both the meter and the calibrator shall be checked.

c) Instrument Calibration. The instrument shall be set to the correct level range, weighting scale and meter response. The calibrator shall be placed on the microphone of the meter. The output indicated on the meter is then adjusted to the correct calibration level using a screwdriver on the adjustment screw.

d) Annual Calibration. Annually, or when determined to be necessary, each set of sound measuring instruments, sound level meter and calibrator, shall be returned for calibration to the manufacturer's specifications. An inspection label will be attached to each instrument set to determine when the calibration was performed.

e) Sound Level Measurement

1 The following steps should be followed before taking a measurement

(a) Turn the meter on.
(b) Switch on the "A" weighting scale.
(c) Switch on the "FAST" meter response.
(d) Set the meter to the appropriate number to measure the anticipated sound level.

2. The sound level meter should be hand-held or placed on a tripod according to the manufacturer's instructions.

3. The orientation of the microphone should be according to the manufacturer's instructions.

4. Allowances are necessary due to unavoidable variations in measurement sites and test equipment. Equipment is not considered in violation unless it exceeds the regulated limit by 2 dBA or more.

5.5 Equipment Test Procedure

5.5.1 Vehicle Sound Level. The sound levels for auxiliary equipment shall be determined by tests performed according to the following procedures.

5.5.2 Location. The microphone shall be located on the microphone line at the position where the maximum sound level is expected to occur (See Figure 5-1).

5.5.3 Preliminary Tests. Sufficient preliminary tests shall be made to enable the operator to become thoroughly familiar with the equipment.

5.5.4 Equipment Operation. The equipment shall be operated at the combination of load and speed which produces the maximum sound level without violating the manufacturer's operation specifications.

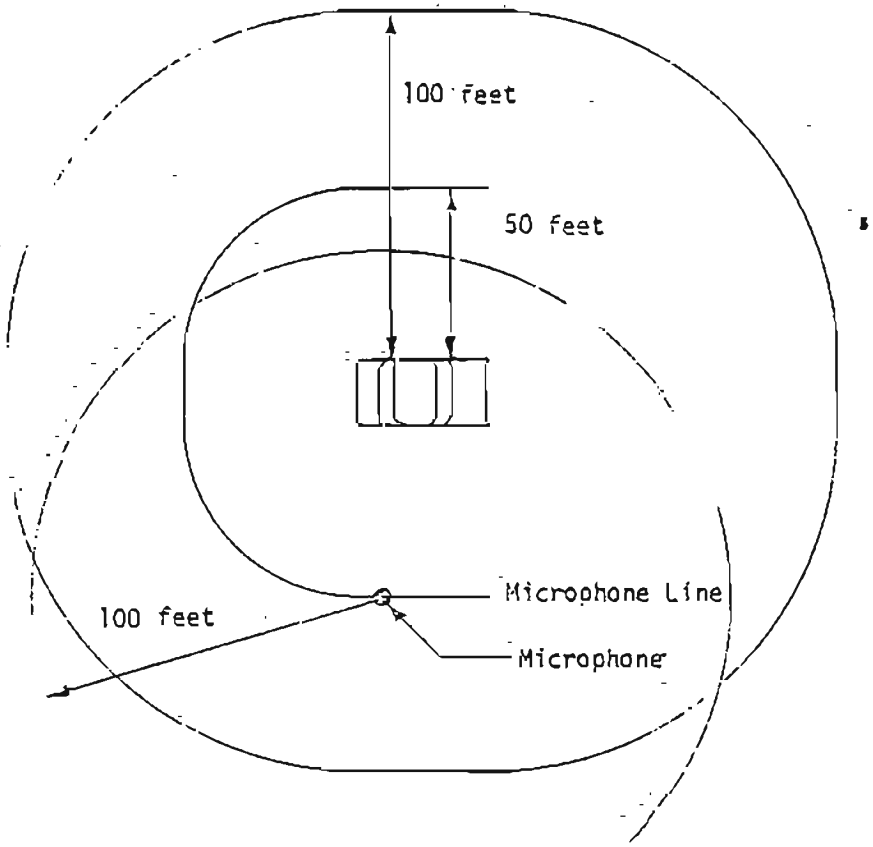


Figure 5-1. Auxiliary Equipment Measurement Site

5.5.5 Visual Reading. The highest sound level observed, exclusive of and peaks due to unrelated ambient noise, shall be reported for each test.

5.5.6 Reported Sound Level. The reported sound level for the vehicle shall be the highest reading which is no more than one dB higher than the next highest reading.

5.5.7 Auxiliary Equipment Test Form. A form to record all pertinent information and data is presented in Figure 5-2. This form, or any other Department approved form for this use, shall be used for auxiliary equipment tests.

AUXILIARY EQUIPMENT NOISE TEST

NOISE POLLUTION DIVISION
DEPARTMENT OF ENVIRONMENTAL QUALITY

DATE

YEAR | EQUIPMENT MAKE | EQUIPMENT TYPE | LICENSE NO. | MODEL

REGISTERED OWNER | ADDRESS

DRIVER | D.L. NO. | ADDRESS

ENGINE TYPE | Primary / Secondary | HP | ENGINE DISPLACEMENT | LOCATION | EQUIP. MILEAGE/HRS.

EXHAUST OUTLET
☐ Single ☐ L. Side ☐ Rear
☐ Dual ☐ R. Side ☐ Vertical

CHECK POSITION AND SIZE OF OUTLET
☐ Straight ☐ 45° to rear
☐ 45° to Side ☐ ___ dia

RESONATORS
☐ Single
☐ Dual

MUFFLER TYPE

RECORDER MODEL AND DEQ NO. | METER MODEL AND DEQ NO. | CALIBRATOR AND DEQ NO.

TEST DRIVER | TEST ENGINEER

METER CHECK
☐ BAT. ☐ WINDSCREEN ☐ "A" SCALE ☐ FAST ☐ CALIB.

OPERATING CONDITIONS	Time	READINGS dBA	READINGS LOCATION NUMBER	MAX. NPN

TEST CONDITIONS

WEATHER CONDITION	TEMP.	R.H.	WIND SPEED

Sketch in this space the measurement site peculiarities, and using the proper symbols indicate the direction of wind, vehicle orientation and reading locations.

Key: WIND DIRECTION - - - ←
VEHICLE . . . —
MICROPHONE LOCATION NO. ⇨

INSTRUMENTATION SET UP AT 50 FT FROM EDGE OF VEHICLE

NPCS-27

Figure 5-2

Auxiliary Equipment Noise Test

CHAPTER 6

NEAR FIELD STATIONARY MOTOR VEHICLE

SOUND LEVEL MEASUREMENTS

20 Inches 1/2 Meter)

6.1 Scope. This chapter establishes procedures for setting up and calibrating sound measuring equipment and conducting tests to determine the sound level output of a stationary vehicle as measured 20 inches (.5 meter) from the exhaust exit. This procedure allows testing indoors and at sites limited in open space.

These procedures are used to conduct emission tests on automobiles, light trucks under 8,000 pounds GVWR, motorcycles and motorboats containing atmosphere terminating exhaust systems. Standards for these vehicles are found in Tables 2 and 4 of OAR 340-35-030.

6.2 Initial Inspection.

6.2.1 Subjective Evaluation. Before a vehicle is tested according to the near field procedures, a subjective evaluation of the vehicle noise shall be made by experienced personnel to determine if an objective test is necessary. The subjective test, using the human ear as a sensing device, shall be conducted at engine idle and during rapid partial throttle opening in neutral gear. The inspector shall stand on the exhaust exit side and near the rear of the vehicle during this evaluation. The exhaust noise shall not be discernably louder than the engine noise and they shall blend together to be acceptable.

6.2.2 Visual Inspection. If a vehicle is found to be subjectively loud, a visual inspection of the exhaust system shall be conducted. This inspection should include the entire system from the engine to the outlet pipe.

COMMENT: Under Oregon Administrative Rules Chapter 340 Section 35-030 the following defects are a violation:

a) No muffler

b) Leaks in the exhaust system

c) A pinched outlet pipe

6.2.3 Near Field Test. If the subjective evaluation warrants further inspection and the visual check does not disclose a violation, then the vehicle shall be subjected to the near field noise test as described in Section 6.5. This test uses a sound level meter to measure the noise level of the vehicle under controlled test conditions.

Measurement Sites.

6.3.1 Vehicle Location. The vehicle must rest on the open water, ground or pavement, the shop floor, or on a dynamometer. It should not be on a hoist, rack, or over a pit. Shop doors should be open to avoid excessively high readings and reflective surfaces should be as far as possible from the sound level meter.

6.3.2 Bystanders. Bystanders should not stand within 10 feet (3 meters) of the microphone or vehicle during noise tests, except for operating personnel.

6.3.3 Wind. Do not conduct noise measurements when wind velocity at the test location exceeds 20 miles per hour (32 km/hr).

6.3.4 Precipitation. Do not conduct noise measurements if precipitation is falling, unless the microphone and instruments are protected from moisture and results are not affected.

Warning: Do not let any moisture on microphone. This will cause damage. Do not attempt to clean microphone.

6.3.5 Ambient Noise. The ambient noise levels shall be at least 10 dBA below the sound level of the vehicle being tested.

Equipment Setup and Use.

6.4.1 Meter Specifications. The specifications for sound level meters are defined in Noise Pollution Control Section manual NPCS-2 Requirements for Sound Measuring Instruments and Personnel. The minimum meter required is a Type II as defined by American National Standards Institute number S1.4-1971.

6.4.2 Battery. A battery check shall be conducted on the Meter and Calibrator before each calibration.

6.4.3 Calibration. The sound level meter shall be field calibrated immediately prior to use following procedures described by the manufacturer's instruction manual. Meters should be calibrated at least at the beginning and end of each business day and at intervals not exceeding 2 hours when the instrument is used for more than a 2-hour period.

COMMENT: If the instrument is damaged or in need of service, contact the Noise Pollution Control office or Motor Vehicles office.

6.4.4 Annual Calibration. Within one year prior to use, each set of sound level meters shall receive a laboratory calibration in accordance with the manufacturer's specifications. This calibration shall be traceable to the National Bureau of Standards.

6.4.5 Windscreens. Windscreens of open cell polyurethane foam furnished by the manufacturer shall be placed over the microphone after calibration. This will protect it from dust or other airborne matter.

Warning: Do not let exhaust gases impinge on microphone.

6.4.6 Meter Setting. The meter shall be set on the "A" scale and used in the slow response mode.

6.4.7 Tachometer. A calibrated engine tachometer shall be used to determine when the test RPM is attained. Tachometers shall have the following characteristic:

Steady state accuracy of ± 2% of full scale.

The tachometer shall be calibrated at least once a year in accordance with manufacturer's calibration procedures.

6.5 Sound Level Measurements.

6.5.1 Preliminary Steps:

a) Field calibration.
b) Windscreen on.
c) Set meter to the appropriate range to measure the anticipated sound level.
d) Switch to "A" weighting scale and slow response mode.
e) Turn meter on.

6.5.2 Mounting. The sound level meter shall be hand-held or placed on a tripod according to the manufacturer's instructions.

6.5.3 Orientation. The orientation of the sound level meter microphone shall be according to the manufacturer's instructions.

COMMENT: Generally, the operating personnel will be to one side. The "General Radio" 1565B Sound Level Meter shall be oriented such that the microphone points aft and the sound path will "graze" the surface of the microphone (See Figure 6.1 and 6.2).

6.5.4 Microphone Position. The microphone for the sound level meter shall be at the same height as the center of the exhaust outlet but no closer to the surface than 8 in. (203 mm). The microphone shall be positioned with its longitudinal axis parallel to the ground, 20 in. (508 mm) from the edge of the exhaust outlet, and 45 ± 10 deg. from the axis of the outlet (Figure 6.1 & 6.2). For exhaust outlets located inboard from the vehicle body, the microphone shall be located at the specified angle and at least 8 in. (203 mm) from the nearest part of the vehicle.

For motorcycles with more than one outlet per side, the measurement shall be made at the rearmost outlet.

Note: If a measuring device is attached to the exhaust outlet and the meter to maintain proper distance, ensure no vibrations from the vehicle are transmitted to the instrument.

6.5.5 Vehicle Operation. Vehicles tested to determine exhaust system sound levels shall be operated as follows:

a) Automobiles and Light Trucks and other Automotive Powered Vehicles. The engine shall be operated at normal operating temperatures with transmission in park or neutral. Sound level measurements shall be made at 3/4 (75%) of the RPM for rated horsepower ± 100 RPM of meter reading.

COMMENT: Tables of the 75% RPM (test RPM) versus the engines are given in the Near Field Motor Vehicle Test RPM Tables, NPCS-31.

b) Motorcycles. The rider shall sit astride the motorcycle in a normal riding position with both feet on the ground. The engine shall be operated at normal operating temperatures with the transmission in neutral. If no neutral is provided, the motorcycle shall be operated either with the rear wheel 5-10 cm (2-4 in) clear of the ground, or with the drive chain or belt removed. The sound level measurement shall be made with the engine speed stabilized at one of the following values:

(A) If the motorcycle engine data is available, test the motorcycle at 1/2 (50%) of the RPM for maximum rated horsepower ± 100 RPM.

(B) If the engine data is not available and if the motorcycle has a tachometer indicating the manufacturer's recommended maximum engine speed ("Red Line"), test the motorcycle at 45% of the "Red Line" RPM ± 100 RPM.

Motorcycle tachometers generally show a red area at the upper part of the scale. The "Red Line RPM" is the lowest value within the red area.

If the engine data and red line RPM are not available, test the motorcycle at:

(i) 3500 RPM ± 100 RPM for motorcycles with total cylinder dispacement between 0-950 cc (0-58 in^3)

(ii) 2800 RPM ± 100 RPM for motorcycles with total cylinder displacement greater than 950 cc (58 in^3)

c) Trucks and Buses. To be determined.

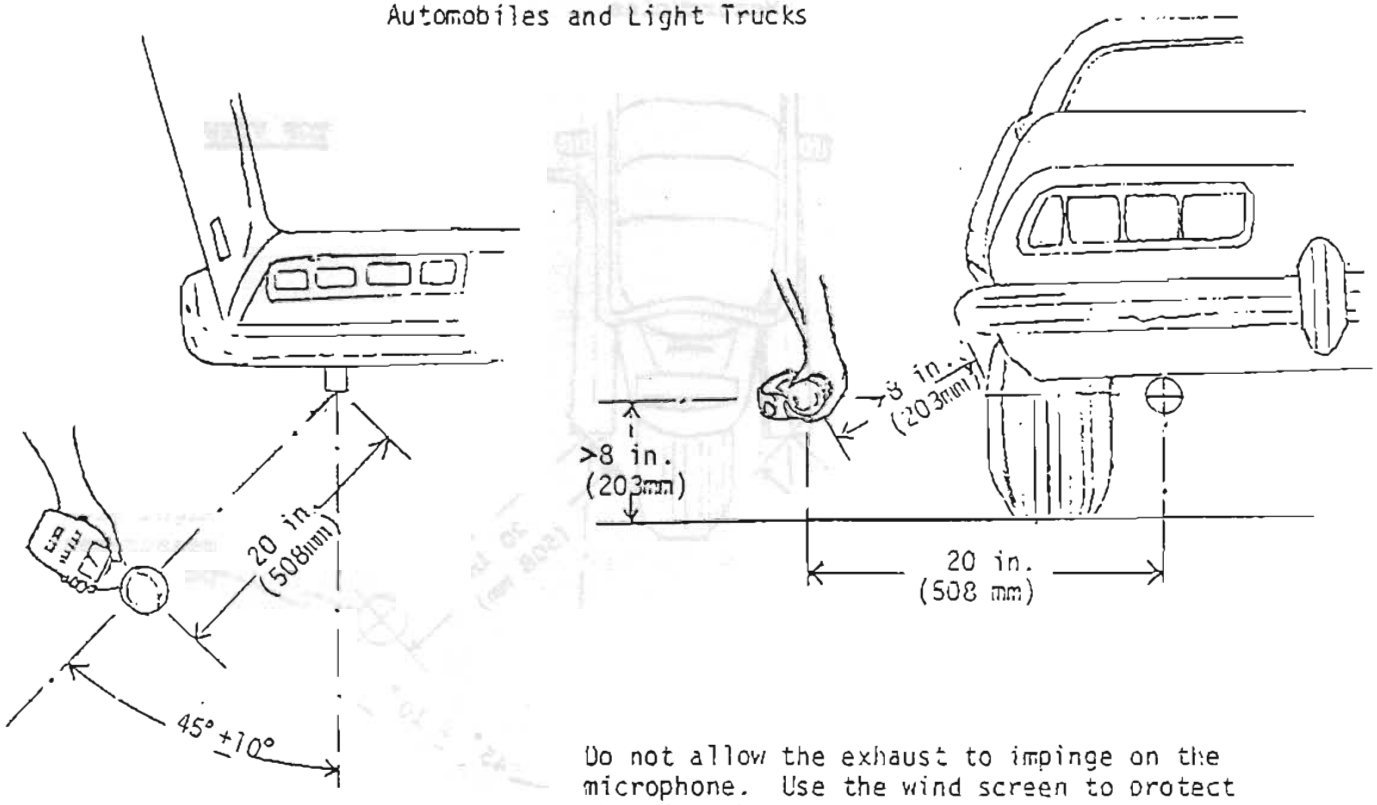
6.5.6 Reported Sound Levels. The reported exhaust system sound level reading shall be the highest reading obtained during the test, exclusive of peaks due to unrelated ambient noise or extraneous impulsive type noise obtained during the acceleration or deceleration portion of the test. When there is more than one exhaust outlet, the reported sound level shall be for the loudest outlet.

COMMENT: The purpose of this test is to measure exhaust noise, so there should not be any other noises within 10 dBA below the exhaust noise (See Ambient Noise).

6.5.7 Variations. Allowances are necessary due to unavoidable variations in measurement sites and test equipment. Vehicles are not considered in violation unless they exceed the regulated limit by the value shown in the following table or more.

Sound Level Meter Type	Allowable Exceedance
ANSI Type I	1 dBA
ANSI Type II	2 dBA

Figure 6.1
Microphone Placement for
Automobiles and Light Trucks



Do not allow the exhaust to impinge on the microphone. Use the wind screen to protect the microphone.

For dual exhausts, measure both and record the higher of the two readings.

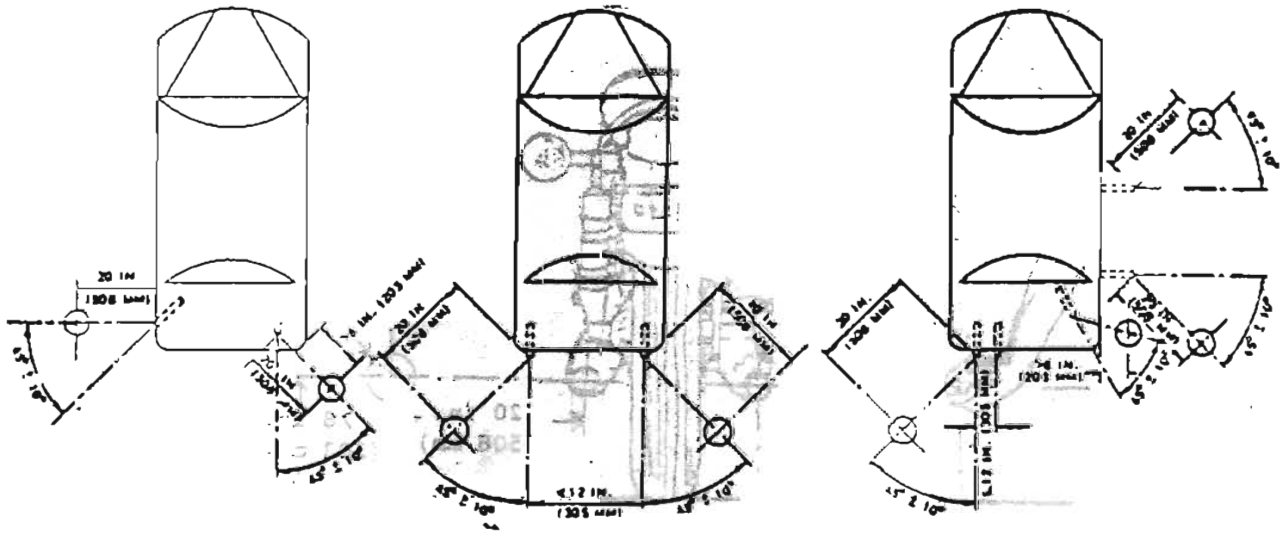
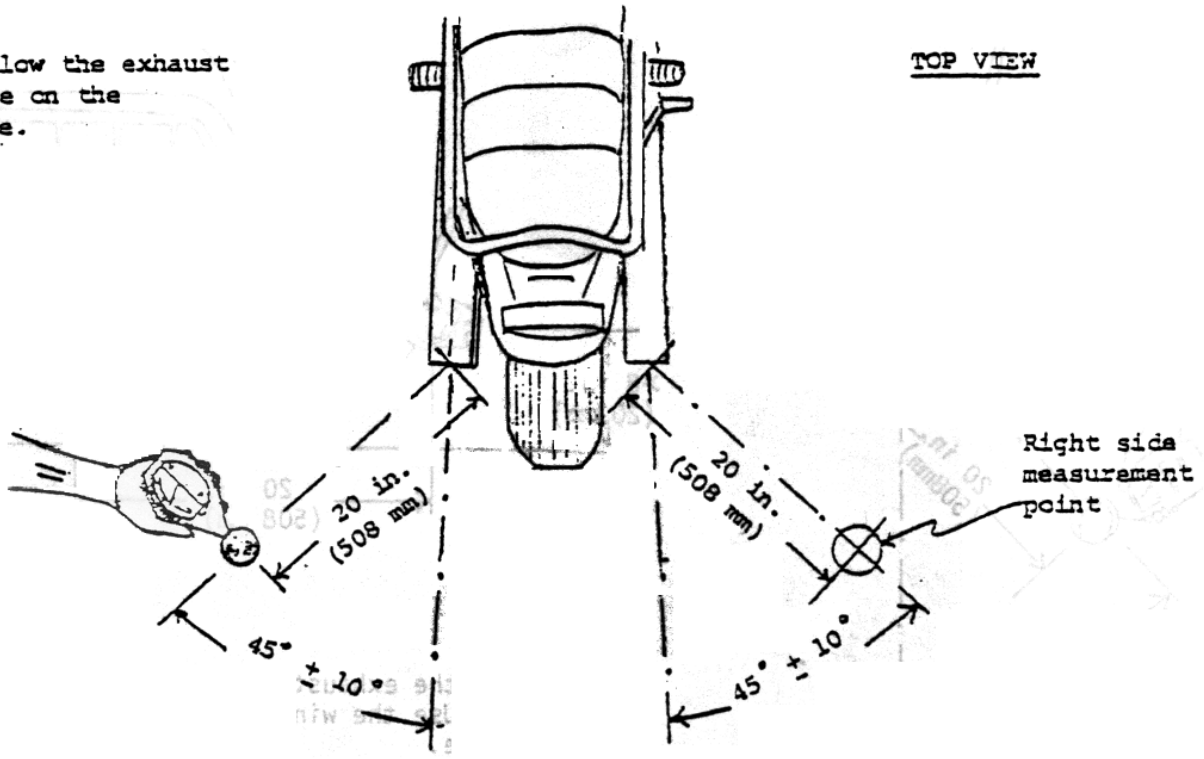


Figure 6.2
Microphone Placement for
Motorcycles

Do not allow the exhaust to impinge on the microphone.

TOP VIEW



For exhaust outlets on both sides, measure both and report the highest of the two readings.

Rear View