COUNCIL DIRECTIVE

of 19 December 1978

on the approximation of the laws of the Member States relating to the determination of the noise emission of construction plant and equipment

(79/113/EEC)

THE COUNCIL OF THE EUROPEAN COMMUNITIES,

Having regard to the Treaty establishing the European Economic Community, and in particular Article 100 thereof,

Having regard to the proposal from the Commission,

Having regard to the opinion of the European Parliament (1),

Having regard to the opinion of the Economic and Social Committee (2),

Whereas in the Member States the permissible noise emission of construction plant and equipment and the method of determining it is subject to mandatory provisions which differ from one Member State to another and consequently hinder trade in such construction plant and equipment; whereas it is therefore necessary to approximate these provisions;

Whereas it is necessary to approximate the requirements for the determination of the noise emission which construction plant and equipment must satisfy in order to be freely imported and marketed,

HAS ADOPTED THIS DIRECTIVE:

Article 1

1. This Directive shall apply to the construction plant and equipment defined in paragraph 2, for which detailed requirements are laid down in separate Directives.

2. For the purposes of this Directive 'construction plant and equipment' means machinery, appliances, plant and installations or components thereof which are used, according to their type, to perform work on civil engineering and building sites but which are not primarily intended for the transport of goods or persons and in respect of which the noise emission should be determined.

3. Agricultural and forestry tractors and lifting appliances are excluded from the scope of this Directive.

Article 2

Where a separate Directive provides for the determination of the noise emission of the plant and equipment referred to in Article 1, this emission shall be determined in accordance with the requirements annexed hereto.

Article 3

Any amendments necessary to adapt the requirements annexed hereto to technical progress shall be adopted in accordance with the procedure laid down in Article 5.

Article 4

1. A Committee on the Adaptation to Technical Progress of the Directives on the Removal of Technical Barriers to Trade in Construction Plant and Equipment, hereinafter called 'the Committee', is hereby set up; it shall consist of representatives of the Member States, with a representative of the Commission as chairman.

2. The Committee shall adopt its own Rules of Procedure.

Article 5

1. Where the procedure laid down in this Article is to be followed, matters shall be referred to the Committee by the chairman, either on his own

(1) OJ No C 76, 7. 4. 1975, p. 37.
(2) OJ No C 263, 17. 11. 1975, p. 42.

initiative or at the request of the representative of a Member State.

2. The representative of the Commission shall submit to the Committee a draft of the measures to be adopted. The Committee shall deliver its opinion on the draft within a time limit set by the chairman, having regard to the urgency of the matter. Opinions shall be adopted by a majority of 41 votes, the votes of Member States being weighted as provided in Article 148 (2) of the Treaty. The chairman shall not vote.

3. (a) The Commission shall adopt the measures envisaged where they are in accordance with the opinion of the Committee.

(b) Where the measures envisaged are not in accordance with the opinion of the Committee, or if no opinion is adopted, the Commission shall without delay propose to the Council the measures to be adopted. The Council shall act by a qualified majority.

(c) If, within three months of the proposal being submitted to it, the Council has not acted, the proposed measures shall be adopted by the Commission.

Article 6

1. Member States shall bring into force the laws, regulations and administrative provisions necessary to comply with this Directive within 18 months of its notification and shall forthwith inform the Commission thereof.

2. Member States shall ensure that the texts of the provisions of national law which they adopt in the field covered by this Directive are communicated to the Commission.

Article 7

This Directive is addressed to the Member States.

Done at Brussels, 19 December 1978.

For the Council

The President

G. BAUM

ANNEX

METHOD OF DETERMINING AIRBORNE NOISE EMITTED BY MACHINES USED OUTDOORS

1. OBJECT

The purpose of this method is to determine the noise emitted by all categories of machines, parts of machines or installations used outdoors. For the purposes of this method, machines, parts of machines and installations are called sound sources.

This method defines the various acoustic criteria which may be adopted to characterize a sound source, and the means of determining these criteria.

The values obtained by this method constitute the basic data for checking that the noise emission of machines complies with requirements, and for the organization of construction sites with regard to protection against noise. Unless otherwise indicated, these values are inclusive of tolerances.

This method is applicable unless separate Directives lay down different or supplementary provisions taking into account the special characteristics of certain types of machine.

2. SCOPE

2.1. Type of noise

This method is applicable to any type of noise emitted by a sound source normally used in the open air.

2.2. Size of sound source

Unless separate Directives provide otherwise, this method is applicable to sound sources of all sizes.

3. DEFINITIONS

3.1. Sound pressure level L_{pA}

The sound pressure level L_{pA} is obtained by applying the weighting A to the sound pressure level L_p.

The sound pressure level L_p, expressed in dB, of a noise is defined by:

$$L_p = 20 \log_{10} \frac{p}{p_o}$$

where:

p is the effective sound pressure value measured at a particular point, expressed in Pa;

p_o is the effective reference sound pressure, equal to 20 μPa.

The value L_{pA} of the A-weighted sound pressure level, expressed in dB, is obtained by applying the weighting A to the measuring system.

3.2. Measuring surface

The measuring surface of area S is a hypothetical surface surrounding the sound source and on which the measuring points are arranged (see 6.4).

3.3. Surface sound pressure level L_{pAm}

The surface sound pressure level L_{pAm} is the root mean square of the sound pressures recorded on the measuring surface, calculated in accordance with the method set out in 8.4.

3.4. **Sound power level L_{WA}**

The sound power level L_{WA} is obtained by applying the weighting A to the sound power level L_W.

The sound power level L_W, expressed in dB, of a sound source is defined by:

$$L_W = 10 \log_{10} \frac{W}{W_o}$$

where:

W is the total sound power generated by the sound source, expressed in watts;

W_o is the reference sound power, equal to 10^{-12} W.

The value L_{WA} of the A-weighted sound power level, expressed in dB, is obtained by applying the weighting A to the measuring system.

3.5. **Limit value of the sound power level L_{WA1}**

The limit value of the sound power level L_{WA}, expressed in A-weighted dB, is that prescribed by the separate Directives and shall be termed L_{WA1}.

3.6. **Directivity index (DI)**

The directivity index (DI), expressed in dB, to be adopted in applying this method is defined by the formula:

$$DI = L_{pAmax} - L_{pAm} + 3$$

where:

— L_{pAmax} is the highest of the sound pressure levels recorded at the measuring points (see 6.4.2), calculated in accordance with 8.1.1 and corrected in accordance with the general principles laid down in 8.6.1, 8.6.3 and 8.6.4,

—L_{pAm} is the surface sound pressure level determined in accordance with 8.4,

— 3 is a conventional additive term.

In determining the values L_{pAmax} and L_{pAm} only the measuring points prescribed need be taken into account.

3.7. **Extraneous noise**

Extraneous noise means the noise resulting from background noise and parasitic noise.

3.7.1. *Background noise*

Background noise means any noise recorded at the measuring points which is not generated by the sound source.

3.7.2. *Parasitic noise*

Parasitic noise means any noise at the measuring points which is generated by the sound source but not directly radiated by it.

4. CRITERIA TO BE USED FOR EXPRESSING RESULTS

4.1. **Acoustic criteria for the environment**

The acoustic criterion for the environment of a sound source shall be expressed:

— either by the sound power level of the sound source L_{WA},

— or by the sound power level of the sound source L_{WA} supplemented by the directivity index (DI). However, when the calculated sound power level L_{WA} is lower than the limit value of the sound power level L_{WA1} by a value specified in the separate Directive, the directivity index (DI) is given only for information.

4.2. **Acoustic criterion at the operator's position**

In principle the acoustic criterion at the operator's position shall be expressed as the sound pressure level L_{pA}.

5. MEASURING INSTRUMENTS

5.1. **General**

The instruments shall be designed to measure the A-weighted level of the root mean square of the sound pressure. The level of the root mean square value in time for a measurement point is obtained either by direct reading of the instrument, or by calculation in accordance with section 11.

5.2. **Measuring instruments**

The following instruments may be used to satisfy the preceding requirement:

(a) a sound level meter meeting the requirements of IEC publication 179, 1973, second edition. The meter shall be set at 'slow' response;

(b) an integrator effecting analog or digital integration of the squared signal over a given time interval.

Note

If, for any measurement, instruments other than a precision sound level meter or combinations of instruments, such as integrators are used, all the specifications of such instruments shall comply with the relevant requirements of IEC publication 179, 1973, second edition.

5.3. **Microphone with cable**

Use shall be made of a microphone with cable complying with IEC publication 179, 1973, second edition, and calibrated for free-field measurement.

5.4. **Weighting network**

Use shall be made of an A-weighting network meeting the requirements of IEC publication 179, 1973, second edition.

5.5. **Inspection of the measuring apparatus**

5.5.1. Before the tests, the acoustic properties of the entire apparatus (measuring instruments including microphone and cable) shall be checked by means of a calibrated sound source with an accuracy of at least 0·5 dB (e.g. a pistonphone); the apparatus shall be checked again immediately after each series of measurements.

5.5.2. These on-the-spot checks shall be supplemented by more thorough calibrations to be carried out at least once a year in a specially equipped laboratory.

6. MEASURING CONDITIONS

All details concerning the installation, operation and use of the sound sources shall be specified in the Annexes to the separate Directives.

The general requirements are given in 6.1 to 6.4.

6.1. **Purpose of the measurement**

All apparatus, such as auxiliary equipment, power generators etc., which forms an integral part of the sound source to be tested shall be accurately defined.

In the case of machines operating with interchangeable devices, such as various items of special-duty equipment, the measurements shall be made at least on the machine fitted with its main device. The results of a measurement shall be valid only for the combination tested.

If necessary, the separate Directives also specify in what way account must be taken, when measurements are being carried out, of the existence of any components which are not, strictly speaking, constituent parts of the machine (separate tools, etc.) but which are essential to its operation.

6.2. **Operation of the sound source during measurement**

With a view to creating reproducible conditions and enabling the characteristic emission values of the sound source to be calculated, the separate Directives shall contain a precise definition of the operating conditions to be fulfilled during measurement.

In principle, each measurement shall comprise:

6.2.1. *A test of the sound source free of load (idling)* at the nominal motor speed, but without operating the working equipment or travelling mechanism.

6.2.2. *Tests carried out under load*

In this case, the operating conditions prescribed shall correspond either to normal working conditions or to conventional working conditions, producing, in principle, effects and stress similar to those undergone under actual working conditions. During measurement, the equipment shall operate steadily or perform a given regular sequence of operations. The operating conditions of each sound source are specified in the Annexes to the appropriate separate Directives.

6.3. **Measuring site**

The sound source shall be installed in free-field conditions and, unless otherwise prescribed, on a reflecting plane corresponding to its actual mode of operation and on a site where extraneous noises are sufficiently low (see 8.6).

Where a non-reflecting surface (e.g. grassy ground) shall be used to perform a test prescribed by a separate Directive the acoustic properties of the surface will be specified in the Directive concerned.

The environment of the measuring site shall be free from reflecting objects which might influence measurement results.

If a reference sound source is used, it shall have the minimum characteristics specified in ISO Standard 3741, Annex B, 1975.07.15.

6.4. **Measuring surface, measuring distance, location and number of measuring points**

6.4.1. *Measuring surface, measuring distance*

The measuring surface is a hypothetical surface enveloping the sound source; it is delimited by the test area on which the machine stands. It may also be delimited by several planes (Figure 1). It shall be of a simple geometrical shape, preferably a hemisphere or a rectangular parallelepiped. The sound source shall be placed at the centre of the test area (Figures 2 and 3).

In principle, large measuring distances shall be chosen.

In the case of the hemisphere, this is achieved when the distance between the hemisphere and the outer surface of the machine is not less than twice the largest dimension (length, width, height) of the sound source.

If no dimension of the sound source to be tested exceeds 4 m, the measuring surface shall preferably be a hemisphere with a radius of 10 m. If none of the dimensions exceeds 1·5 m, the measuring surface shall be a hemisphere with a radius of 4 m.

In the case of very large sound sources, practical difficulties arise in carrying out the tests. In this case, use of a parallelepiped as the measuring surface presents certain advantages.

Where the Annexes to the separate Directives lay down special measuring surfaces, these alone shall be taken into consideration.

Notes

(a) Projecting parts of the sound source which do not make an essential contribution to acoustic radiation shall not be taken into consideration in determining the dimensions of the sound source.

(b) In the case of sound sources of which the greatest of the three dimensions (length, width, height) exceeds half the measuring distance, there will be increased uncertainty regarding measuring results. Such uncertainty can be reduced by increasing the number of measuring points. If the distance between two neighbouring measuring points is less than the measuring distance, the precision of the measurement will be comparable to that obtained with the hemisphere as defined above.

6.4.2. *Location and number of measuring points*

6.4.2.1. General

If, owing to its geometric shape or its method of operation (e.g. movement), the sound source shows marked directional properties, the measuring points shall be distributed on the basis of a system of coordinates to be established accordingly; the origin of the system of coordinates shall, where possible, coincide with the projection on the test area of the geometric centre of the sound source.

6.4.2.2. Position of the measuring points on a hemisphere of radius r

In the case of a hemisphere there shall, in principle, be 12 measuring points with the following coordinates (see Figure 2):

$$x = (x/r)\, r$$
$$y = (y/r)\, r$$
$$z = (z/r)\, r.$$

The values x/r, y/r, z/r and z are given in Table I below:

TABLE I

	x/r	y/r	z/r	z
1	1	0	—	1·5 m
2	0·7	0·7	—	1·5 m
3	0	1	—	1·5 m
4	-0·7	0·7	—	1·5 m
5	-1	0	—	1·5 m
6	-0·7	-0·7	—	1·5 m
7	0	-1	—	1·5 m
8	0·7	-0·7	—	1·5 m
9	0·65	0·27	0·71	—
10	-0·27	0·65	0·71	—
11	-0·65	-0·27	0·71	—
12	0·27	-0·65	0·71	—

6.4.2.3. Position of measuring points on a parallelepiped

If the measuring surface is situated on a parallelepiped, the measuring points are, for example, as shown in Fig. 3. The number of measuring points and their arrangement depend on the size of the source. However, there shall be at least one measuring point at the centre of each face (as a general rule four lateral faces and one upper face) and at the four corners of the upper face of the parallelepiped. Note (b) in 6.4.1 shall also be taken into consideration.

Note concerning 6.4.2.2 and 6.4.2.3

The separate Directives may prescribe a different arrangement for the measuring points and a different number thereof.

6.5. **Measurements at the operators's position**

If operation of the machine requires the presence of an operator (for example the driver), additional measurements should be made at the operator's position.

Detailed specifications in this connection will be given elsewhere.

7. MEASUREMENTS

7.1. **Measurement of the acoustic properties of the measuring site**

The environmental conditions at the measuring site shall be checked before measurements are carried out. The following factors shall be checked:

(a) extraneous noise;

(b) wind interference;

(c) operating conditions such as vibrations, temperature, humidity, barometric pressure;

(d) acoustic properties of the test area;

(e) acoustic reflections from obstacles in the measuring site which might affect the results of the measurements.

7.1.1. *Extraneous noise*

The Annexes to the separate Directives will specify which extraneous noise shall be taken into consideration.

(a) Measurement of background noise

Background noise shall be recorded at the measuring points (see 6.4.2) with the sound surface switched off (no sound emission) (see method given in 7.2).

(b) Measurement of parasitic noise

Parasitic noise shall be recorded at the measuring points (see 6.4.2), if necessary once the sound source to be examined has been isolated by means of screens (see method given in 7.2).

Note

For such screens a surface mass of 25 kg/m² is generally adequate. It is preferable for the side facing the sound source to be tested to be sound-absorbing.

7.1.2. *Wind speed and direction*

The wind speed and direction are established at a point above the test area. Account shall be taken of the provisions laid down in 8.6.4.

7.1.3. *Measurement of temperature, humidity, barometric pressure and other disturbances*

Only disturbances likely to have a bearing on the acoustic measurements need be measured (see 8.6.3).

7.1.4. *Acoustic quality of the test area*

The acoustic quality of the test area may be characterized by the environmental constant C as defined in 8.6.2.

The procedure to be followed for determining the value of C defined in 8.6.2 will be given elsewhere. This constant C also allows an assessment to be made as to whether partially reflecting ground can be validly used as a test area.

7.1.5. *Presence of obstacles*

A visual check is in general adequate to ensure that the provisions of the third paragraph of 6.3 have been complied with. The zone to be checked is laid down in the separate Directives.

7.2. **Measurement of the sound pressure level L_{pA}**

To measure the sound pressure level L_{pA}, use shall be made of an instrument as defined in 5.2. The sound pressure level L_{pA} at a given measuring point is the root mean square value in time of the sound pressures. If a sound level meter is used, a number of readings shall be taken at this point and their mean value in time calculated in accordance with section 11.

In principle, the measuring time at each measuring point shall be 15 sec. In the case of work cycles with periodic level variations, the measuring time shall, in principle, cover at least three complete work cycles. If an integrator is used, the integrating time shall be equal to the measuring time.

7.3. **Determination of the nature of the noise generated by the sound source**

For reasons of environmental protection the nature of the noise emitted should be identified so that an assessment may be made of the annoyance caused. Consequently it is appropriate to define a method of characterizing noise of an impulsive character and noise with discrete tones.

7.3.1. *Detection of noise of an impulsive character*

Comparison of the readings on a precision sound level meter set at 'slow' response with those of a precision impulse sound level meter set at 'impulsive' response (IEC Publication 179 A/1973) allows an assessment to be made of whether or not a noise is of an impulsive character. According to this measurement procedure, the difference between the root mean square values in time of the sound pressure levels measured with the sound level meter at slow and impulsive response respectively is taken as an indication of the impulsive character of a noise. The sound pressure level obtained with the 'impulsive' response is referred to as the 'impulsive sound pressure level'.

This shall be determined at one of the measuring points laid down.

A noise is considered to be impulsive in character if the difference between the two abovementioned levels is greater than or equal to 4 dB.

7.3.2. *Detection of a noise with discrete tones*

(7.3.2 is being revised to take account of technical progress; the final text will be introduced by the 'Committee on Adaptation to Technical Progress' procedure.)

8. USE OF RESULTS

8.1. **Calculation of root mean square values**

8.1.1. *Root mean square value at a measuring point*

The values obtained from the measurements referred to in 7.2 are root mean square values in time.

8.1.2. *Root mean square value on the measuring surface*

The level corresponding to the root mean square value in space of the sound pressure levels for all the measuring points shall be calculated on the basis of the values established in accordance with the method described in 8.1.1.

8.2. **Calculation of average extraneous noise level**

The average extraneous noise level over the measuring surface is obtained by applying the method described in 8.1.2 to the extraneous noise levels established at the different measuring points.

The extraneous noise level at a measuring point is equal to the combined mean square values of the sound pressures due to background noise and parasitic noise respectively at that point.

8.3. **Calculation of the area S of the measuring surface**

In the case of a hemisphere, the area S, expressed in m^2, of the measuring surface is determined as follows:

$$S = 2\pi r^2$$

where r = the radius of the measuring hemisphere in m.

In the case of a parallelepiped, the area S, expressed in m^2, of the measuring surface is determined as follows:

$$S = 4(ab + bc + ca)$$

where:

$2a = 2d + l$ lenght of the measuring surface in m;

$2b = 2d + e$ width of the measuring surface in m;

$c = d + h$ height of the measuring surface in m;

d distance separating the measuring surface from the sound source in m;

l length of the sound source in m;

e width of the sound source in m;

h height of the sound source in m.

The area of the measuring surface may be calculated approximately. It should be noted that an error of ± 20 % in this area gives a deviation of ± 1 dB in the value of the term

$$10 \log_{10} \frac{S}{S_o} \text{ (surface level)}$$

8.4. **Calculation of the surface sound pressure level L_{pAm}**

The surface sound pressure level is the level calculated in accordance with the method described in 8.1.2 and then corrected as described in 8.6.1, 8.6.3 and 8.6.4.

8.5. **Calculation of the sound power level L_{WA}**

The sound power level L_{WA} of the sound source is calculated by means of the following equation:

$$L_{WA} = L_{pAm} + 10 \log_{10} \frac{S}{S_o} + K_2$$

where:

L_{WA} = the sound power level of the source tested, expressed in dB (see 3.4);

L_{pAm} = the surface sound pressure level, expressed in dB, as defined in 3.3;

S = the area of the measuring surface in m^2, calculated in accordance with the method described in 8.3;

S_o = reference area of 1 m^2;

K_2 = correction term for the test area, expressed in dB. This equals zero unless, in the light of the provisions of 8.6.2 together with those of the separate Directives, it should equal C.

Note (see 6.4.1)

Where r = 4 m, $10 \log_{10} \frac{S}{S_o} = 20$ dB.

Where r = 10 m, $10 \log_{10} \frac{S}{S_o} = 28$ dB.

8.6. **Corrections to be made to measurements**

8.6.1. *Extraneous noise*

The average sound pressure level over the measuring surface, calculated in accordance with the method described in 8.1, shall be corrected, if necessary, to take account of the extraneous noise determined in accordance with the method described in 8.2. The correction K_1, in dB, which shall be subtracted from the average sound pressure level over the measuring surface is given in Table II.

TABLE II

Difference (in dB) between the sound pressure level calculated when the sound source is operating and the sound pressure level due to extraneous noise alone	Correction K_1 in dB
less than 6	no valid measurement
6	1·0
7	1·0
8	1·0
9	0·5
10	0·5
more than 10	no correction

8.6.2. *Acoustic properties of test area*

The constant C, which indicates the acoustic properties of the test area, is determined by the following equation:

$$C = L_{WAr} - L_{WAs}$$

where:

L_{WAr} = nominal sound power level of the reference source, expressed in dB;

L_{WAs} = sound power level of the reference source, calculated on the basis of measurements made on the test area, account being taken of 7.1 ((a), (b) and (c)).

If the ground surface of the test area is rigid and made of concrete or non-porous asphalt and if there are no reflecting objects on the measuring site, there is no need to determine any environmental constant C.

In the case of a partially reflecting ground surface, the value of C must be between limit values laid down in the separate Directives. The effective value of C, which indicates the acoustic properties of the measuring site used, is determined by the above equation.

This value is used as K_2 for fixing the sound power level of the source, unless otherwise specified in the separate Directives.

Further corrections relating to the operation of the sound source (e.g. the altitude of the measuring site) should also be made.

8.6.3. *Disturbances: temperature, humidity, altitude of site etc.*

— Measuring apparatus:

The manufacturer's instructions should be followed in order to take account of any effects of all the disturbances mentioned by him, such as temperature, barometric pressure, humidity.

— Sound source:

The separate Directives will indicate any disturbances likely to affect measurements and specify how they are to be taken into account.

8.6.4. *Wind interference*

The maximum permissible wind speed is 8 m/sec.

Above the wind speed indicated by the manufacturer, microphones shall be equipped with a wind-screen. Any corrections to be made to the calculations referred to in 8.4 are indicated by the wind-screen manufacturer.

9. DATA TO BE RECORDED

In principle, the following information shall be compiled and recorded in a report concerning all measurements made in accordance with the specifications for this method of measurement.

9.1. **Sound source under test**

(a) description of the sound source under test (including dimensions);

(b) operating conditions of the sound source during the tests;

(c) conditions for installation on the test area;

(d) location of sound source on measuring site;

(e) if the machine tested has multiple noise sources, description of sources in operation during measurement.

9.2. **Acoustic environment**

(a) description of the measuring site, including physical characteristics of the test area; diagram showing the location of the sound source and any reflecting objects on the measuring site;

(b) meteorological conditions: weather (e.g. sunshine, cloud, rain, fog), air temperature, barometric pressure, wind speed and direction, humidity;

(c) correction constant representing the acoustic properties of the test area.

9.3. **Instrumentation**

(a) equipment used for the measurements, including the name of the equipment, type, serial number and name of manufacturer;

(b) method used to calibrate the measuring equipment in accordance with 5.5.1.

Name of laboratory which carried out the calibration required in 5.5.2. and date of last calibration.

9.4. **Acoustic data**

(a) shape and dimensions of measuring surface, location of microphones. Numbers of measuring points and wind direction shall be indicated in the diagram required under 9.2 (a);

(b) area S of measuring surface in m^2 (see 8.3) and value of $10 \log_{10} \frac{S}{S_o}$ (see 8.5);

(c) sound pressure levels recorded at measuring points (see 8.1.1);

(d) average sound pressure level over measuring surface (see 8.1.2);

(e) any dB corrections (see 8.6.1, 8.6.3 and 8.6.4);

(f) surface sound pressure level L_{pAm} (see 8.4);

(g) environmental constant C (see 8.6.2);

(h) sound power level (see 8.5);

(i) directivity index and number of the measuring point at which L_{pAmax} was recorded (see 3.6);

(j) nature of noise (see 7.3);

(k) where applicable, sound pressure levels at operator's position (see 6.5);

(l) date and time of measurements.

10. DATA TO BE INCLUDED IN THE REPORT LAID DOWN IN SECTION 9

Only those data recorded in accordance with section 9 and required for the purposes of the measurements shall be reported. The report shall state clearly that the sound power levels were obtained in full compliance with this measuring method. It shall specify that these sound power levels are given in A-weighted dB, reference 1 pW.

11. METHOD OF CALCULATING THE AVERAGE LEVEL CORRESPONDING TO THE ROOT MEAN SQUARE VALUE OF THE VARIOUS SOUND PRESSURE LEVELS

The root mean square value of the various sound pressure levels resulting either from a series of measurements made at a single point (root mean square in time) or from a series of measurements made at different points on the measuring surface (root mean square in space) can be determined by the following formula:

$$L_{pAm} = L_{pAo} + 10 \log_{10} \frac{1}{n} \sum_{i=1}^{i=n} g_i = L_{pAo} + 10 \log_{10} g_m$$

where:

L_{pAi} equals the sound pressure level of the i-th measurement;

L_{pAo} is an auxiliary sound pressure level to simplify the calculation (for example, the smallest of the L_{pAi} values);

g_i is the auxiliary variable for the i-th measurement: $g_i = 10^{0{\cdot}1} (L_{pAi} - L_{pAo})$;

g_m is the mean value of the g_i variables: $\frac{1}{n} \sum_{i=1}^{i=n} g_i$

The quantity $\triangle L$ is defined by:

$$\triangle L = L_{pAi} - L_{pAo}$$

Table III gives the values of g for different values of $\triangle L$.

TABLE III

Value of g as a function of △ L

The table may be extended in either direction.

ΔL dB	g	ΔL dB	g	ΔL dB	g	ΔL dB	g	ΔL db	g
- 20·0	0·010	- 10·0	0·100	0·0	1	10·0	10·0	20·0	100·0
- 19·5	0·011	- 9·5	0·112	0·5	1·12	10·5	11·2	20·5	112·0
- 19·0	0·013	- 9·0	0·126	1·0	1·26	11·0	12·6	21·0	125·9
- 18·5	0·014	- 8·5	0·141	1·5	1·41	11·5	14·1	21·5	141·3
- 18·0	0·016	- 8·0	0·158	2·0	1·58	12·0	15·8	22·0	158·5
- 17·5	0·018	- 7·5	0·178	2·5	1·78	12·5	17·8	22·5	177·8
- 17·0	0·020	- 7·0	0·2	3·0	2·00	13·0	20·0	23·0	199·5
- 16·5	0·022	- 6·5	0·224	3·5	2·24	13·5	22·4	23·5	223·9
- 16·0	0·025	- 6·0	0·251	4·0	2·51	14·0	25·1	24·0	251·2
- 15·5	0·028	- 5·5	0·282	4·5	2·82	14·5	28·2	24·5	281·8
- 15·0	0·032	- 5·0	0·316	5·0	3·16	15·0	31·6	25·0	316·2
- 14·5	0·035	- 4·5	0·355	5·5	3·55	15·5	35·5	25·5	354·8
- 14·0	0·040	- 4·0	0·398	6·0	3·98	16·0	39·8	26·0	398·1
- 13·5	0·045	- 3·5	0·447	6·5	4·47	16·5	44·7	26·5	446·7
- 13·0	0·050	- 3·0	0·501	7·0	5·01	17·0	50·1	27·0	501·2
- 12·5	0·056	- 2·5	0·562	7·5	5·62	17·5	56·2	27·5	562·3
- 12·0	0·063	- 2·0	0·631	8·0	6·31	18·0	63·1	28·0	631·0
- 11·5	0·071	- 1·5	0·708	8·5	7·08	18·5	70·8	28·5	707·9
- 11·0	0·079	- 1·0	0·794	9·0	7·94	19·0	79·4	29·0	794·3
- 10·5	0·089	- 0·5	0·891	9·5	8·91	19·5	89·1	29·5	891·3
- 10·0	0·100	- 0·0	1	10·0	10	20·0	100	30·0	1 000·0

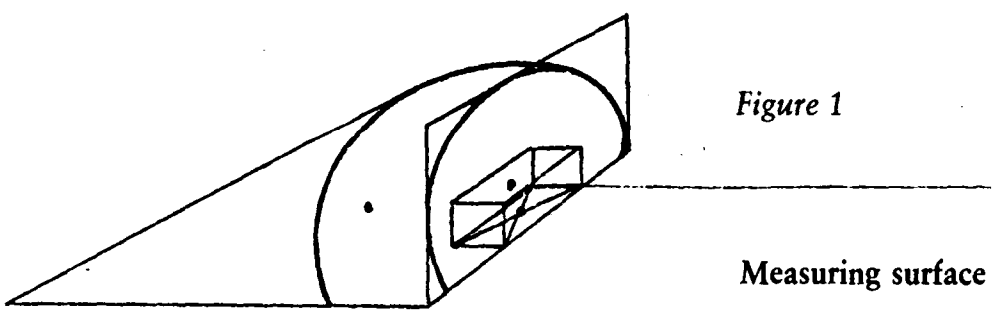

Figure 1

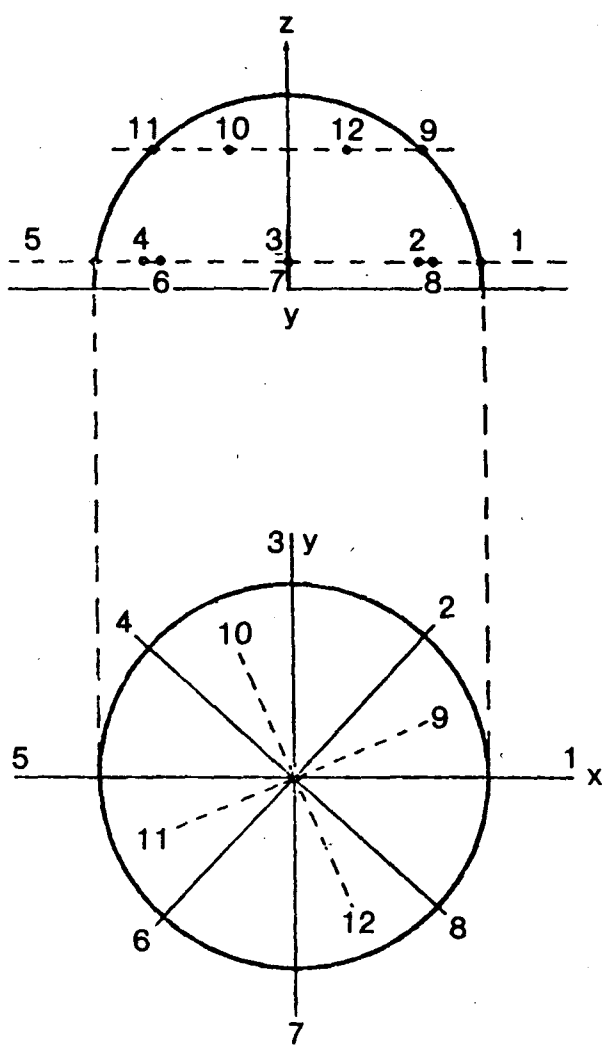

Figure 2

Hemispherical measuring surface

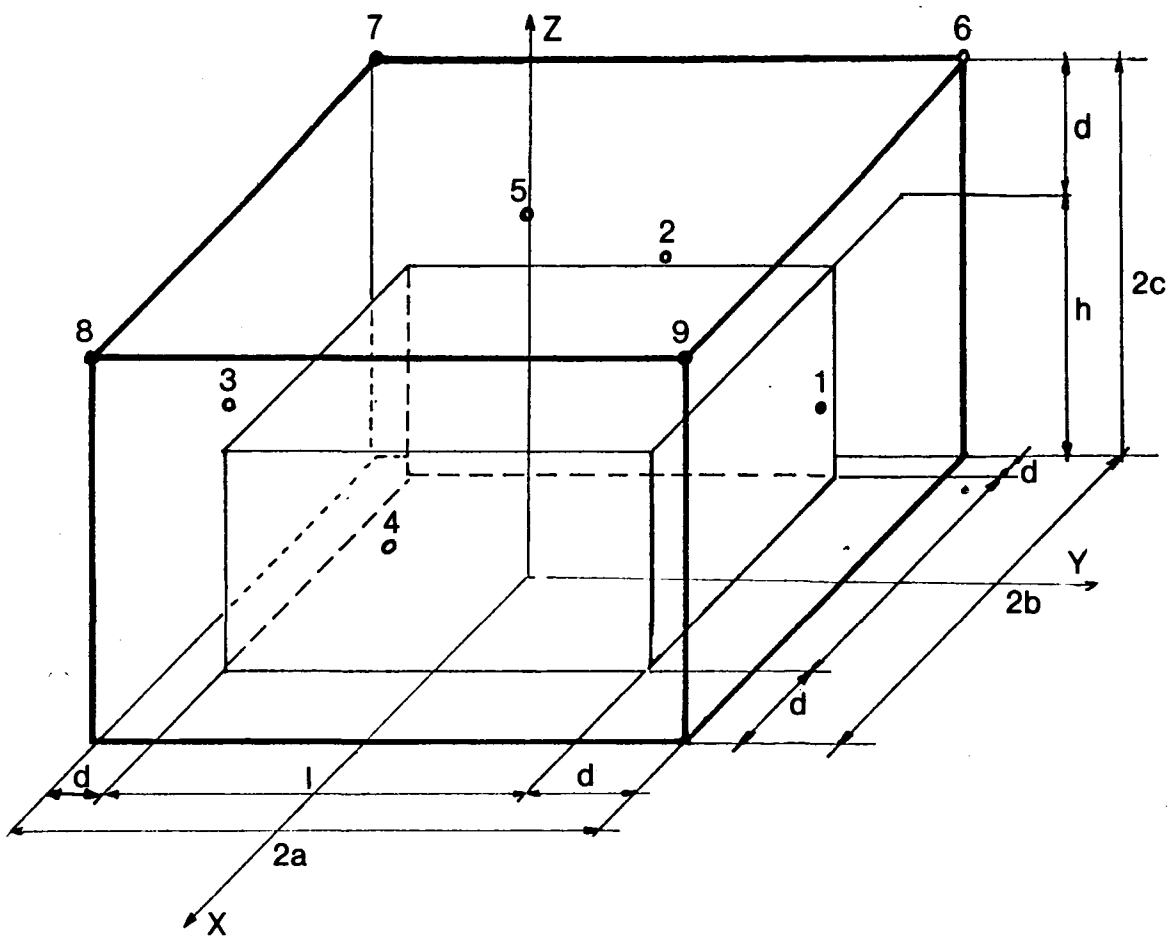

Figure 3

Parallelepiped measuring surface