

REPORT

Assessment of Reproducibility Uncertainties for use in International Standards on the Determination of Sound Power

Richard Payne and Dan Simmons

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ABSTRACT

A programme of inter-laboratory measurements designed to obtain estimates of the standard deviation of reproducibility associated with sound power level determinations has been carried out. These values of reproducibility uncertainty have been compared with values based on repeatability data, and uncertainty values suitable for inclusion in international standards are proposed. Four Laboratories carried out sound power level determinations using a hemispherical enveloping surface on three noise sources encompassing a wide range of acoustic complexity and covering a Directivity Index range from 0.8 dB to 6.9 dB. Sound power levels were determined using several microphone arrays with differing distribution on the enveloping surface and with between twenty and one measurement positions, and reproducibility uncertainties calculated for each array.

The magnitude of reproducibility standard deviations is dependent on the number of microphone positions in the array, the Directivity Index of the noise source and the distribution of the microphone positions.

For A-weighted sound power levels, a procedure is proposed that, for a given value of Directivity Index, will enable the user of a sound power standard to easily assess how many microphone positions are required in an array to obtain a required value of reproducibility, or, to assess the reduction in reproducibility that will be achieved by increasing the number of microphone positions. Standard deviations of reproducibility in a form suitable for inclusion in an international standard are proposed.

For the purposes of an international standard it is suggested that a 10-microphone array should be specified when considering one-third octave-band sound power levels and that a value of reproducibility standard deviation of 1.5 dB across the frequency range from 50 Hz to 10 kHz should be adopted.

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1. INTRODUCTION

In recent years a large number of European Directives have been published, containing requirements for determining the sound power levels of machines. The forerunner was Directive 79/113/EEC¹, which included a general method of determining the sound power level of construction plant and equipment. This was implemented by Directive 84/532/EEC² and several subsequent related directives, which imposed sound power limits on a wide range of machines used on construction sites. Separately from these, Directive 86/594/EEC³ made provision for labelling household appliances with their A-weighted sound power level on a voluntary basis, and this was followed by Directive 92/75/EEC⁴ which made the noise labelling mandatory. Directive 89/392/EEC⁵ (the Machinery Directive) covers the safety of a wide range of machinery types, and it requires manufacturers to give information on the sound power level if the A-weighted sound pressure level at the work station of a machine exceeds 85 dB. In addition to all these, there is another new directive now under consideration which will address the noise emitted by machinery used outdoors⁶. This is intended to supersede some of the earlier directives, it concerns some sixty machine types and will require that all machines are labelled with their A-weighted sound power level and will include some new noise limits.

The Machinery Directive is one of the “new approach” kind, which allows manufacturers to refer to standards in order to demonstrate compliance with the requirements. The new directive on machinery used outdoors will similarly refer to published standards. In order to produce the necessary standard noise test specifications, CEN and ISO are working closely together on various methods of measurement, to suit different acoustical conditions. The standards of interest for present purposes are all type B within the CEN hierarchy, that is they apply in principle to the noise of a wide range of machinery types. Type C standards, giving detailed machinery-specific methods will be based on these, and they will select and refer to individual type B standards for the appropriate method of noise measurement.

The measurement procedures called up in the proposed new Directive are taken from the series of international standards that are concerned with the determination of sound power and in particular those that determine sound power levels in approximately hemi-anechoic conditions from measurements of sound pressure level around the machinery by carrying out a series of measurements over a hypothetical surface surrounding the source. The Standard generally used as the basis for all sound power determinations is ISO 3744:1994⁷. This standard requires the use of hemispherical or parallelepiped measurement surfaces and is considered by many users as being too complicated and time consuming to use. The usefulness of a sound power measurement standard depends on the speed and accuracy with which results are obtained. The shape and size of the hypothetical surface and the way in which the sound field is sampled affects the accuracy and speed of the measurement. Generally, the more samples that are taken, the higher the grade of accuracy and the longer the measurement takes.

In a recent Report⁸ an efficient standardised measurement technique to obtain rapid and accurate sound power measurements suitable for presentation of noise information in accordance with the various EC directives was identified. It was proposed that a new series of sound power standards should be produced, ultimately to replace all the existing ones. The measurement method would be to relate the number of measurements of sound pressure level to the measurement uncertainty associated with the resultant sound power determination,

allowing the number to be increased in order to achieve improved accuracy if required. The report provided data on measurement uncertainty based on repeatability standard deviations.

The EC Directive relating to the noise of machines used outdoors requires that machines are labelled with a guaranteed A-weighted sound power level. The Directive defines this as a sound power level that includes the uncertainties due to production variation and measurement procedures. This guaranteed sound power level is defined in ISO 4871:1997⁹ (in ISO 4871 it is termed the declared level) as a maximal statistical value that is not exceeded for a given confidence level. This standard requires the addition of an uncertainty value to measured noise levels. It may be that the increase in declared noise level resulting from the addition of this uncertainty will affect sales of a particular machine or, for machines that are subject to noise limits, it may result in the machine having to be withdrawn from the European market. Thus, it is of prime importance that the sound power level is accurately determined and the level of measurement uncertainty is carefully specified. The measurement uncertainty required for this labelling process is revealed by the reproducibility of results when a given method is applied by different organisations, by different operators, using different equipment.

This Report describes a programme of inter-laboratory measurements designed to obtain estimates of the standard deviation of reproducibility. These values of reproducibility uncertainty will be compared with the values obtained by Reference 8, based on repeatability data, with a view to providing uncertainty values suitable for inclusion in the proposed new series of standards

2. PROGRAMME DESIGN CONSIDERATIONS

2.1 REPRODUCIBILITY TESTING

The objective of the project was to acquire data on the uncertainties in the determination of sound power levels, expressed in terms of standard deviations of reproducibility. To obtain reproducibility uncertainties it is necessary for the noise emission levels of a particular noise source to be measured,

- by the same method,
- by different laboratories (in different locations),
- by different personnel,
- using different measurement apparatus,
- at different times.

The test programme was drawn up, following the guidance of ISO 5725-2¹⁰ which deals with experiments to determine reproducibility of measurements, to provide the best balance between the number of repeated measurements and number of laboratories performing the tests with statistical confidence and measurement effort.

2.2 NOISE SOURCE CONSIDERATIONS

The standard deviations of reproducibility required for incorporation into standards must be applicable to all types of noise source covered by the standards. The variety of noise sources to which the standards are applicable requires that measurements are made on several noise sources in order to cover a wide range of Directivity Index.

Thirty-two noise sources (actual machines and specially constructed devices) were used in reference 8 with a range of Directivity Index from 0.8 dB to 8 dB and an estimate of measurement uncertainty was associated with each. The purpose of the current series of measurements is to assess how these estimates compare with reproducibility values. However, because of the logistical difficulties involved with using such a large number of noise sources, it was decided to limit the number of noise sources to just three: a reference sound source with an A-weighted Directivity Index of 0.8 dB and a specially constructed source with Directivity Index of 6.9 dB, to examine the “extremes” of the Directivity Index range and a diesel-engined electrical power generator (Directivity Index of 1.3 dB) to include data for a real machine. The three sources used in the test programme are described in sub-section 3.1. The same machines were used in all the tests, in order to achieve consistency of results.

2.3 SELECTION OF MEASUREMENT ORGANISATIONS

Measurements made by only one or two teams of observers, or at only one test site, or with only one set of apparatus, would not be sufficient to obtain reproducibility uncertainties. Thus, it was necessary to recruit other independent laboratories to the project, and to obtain a statistically valid assessment of reproducibility uncertainties it was considered necessary to involve at least three laboratories in addition to NPL.

Six organisations were approached by NPL to undertake the programme of measurements (described in Section 3) on the three selected machines. They comprised laboratories holding NAMAS accreditation by UKAS for measurements of machinery noise and other organisations with appropriate facilities and experience in machinery noise measurement. In selecting the organisations which carried out the measurement work, the following factors were considered:

- past experience in machinery noise determination,
- qualification of test environments and facilities,
- suitability of test equipment available to the laboratory.

Three were selected having satisfied NPL that they would be capable of carrying out the programme. The three laboratories were supervised by NPL through regular contact and by scrutiny of test results submitted for analysis.

2.4 MEASUREMENT METHODS

As outlined in Section 1, the Standard generally used as the basis for all sound power determinations is ISO 3744:1994. The proposed EC Directive concerning the noise from equipment used outdoors generally requires the use of a hemispherical enveloping surface. Previous studies ^{8, 11, 12} have indicated that the measurement uncertainties associated with hemispherical and parallelepiped surfaces are similar and in fact the current series of sound power standards provides only a single set of reproducibility uncertainty values that are applicable to both types of surface. It was decided therefore to concentrate the measurement effort on sound power levels determined according to ISO 3744 using a hemispherical surface. A measurement configuration for a hemispherical surface is shown in Figure 1 for the 10 key microphone positions from ISO 3744.

The noise source dimensions are described in ISO 3744 in terms of the size of the “reference box” and d_o , the “characteristic dimension”. The reference box is a hypothetical surface which is the smallest rectangular parallelepiped that just encloses the source and terminates on the reflecting plane. The characteristic dimension is half the length of the diagonal of the box consisting of the reference box and its images in adjoining reflecting planes. Reference 12 indicated that the determined sound power was dependent on the size of the hemispherical enveloping surface if the radius was less than about three times the characteristic dimension. Consequently the hemisphere radius used in this study is the smallest whole integer that is larger than approximately three times the characteristic dimension. Details of the experimental program are given in Section 3.

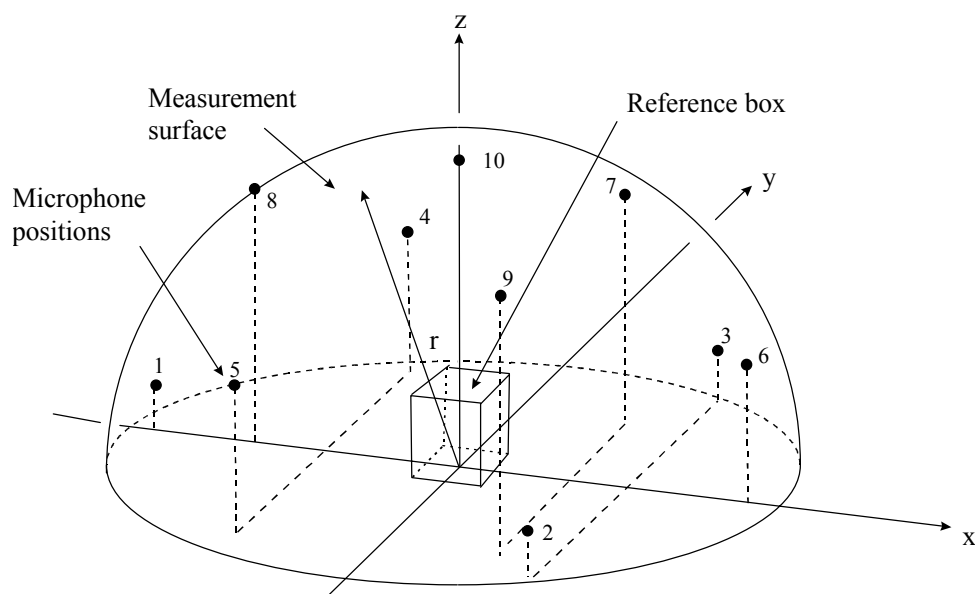


Figure 1 Hemispherical measurement configuration for ISO 3744

3. EXPERIMENTAL PROGRAMME

This Section describes the three noise sources and gives details of the measurement programme undertaken by the four laboratory's. Measurements were made on all three noise sources by each Laboratory over a two week period with an overall measurement period of about two months. Measurements were also carried out by one of the Laboratories on all noise sources at each laboratories test site as soon as practicable after each had completed the required measurements. The purpose of this was twofold: as a check on the stability of the sources and to obtain environmental correction data in order to assess the effect of differing hemi-anechoic locations.

3.1 NOISE SOURCES.

As outlined in sub-section 2.2, tests were conducted on three noise sources supplied by NPL, comprising a reference sound source (RSS), a diesel-engined electrical power generator (generator) and a reference sound source in an enclosure (box source). All were used free-standing on the floor of the test area. There may be some doubt as to the long term stability of the noise level of the real machine used so it was decided that the two noise sources used to examine the "extremes" of the probable Directivity Index range should be based on a reference sound source. A reference sound source is a stable, calibrated, omnidirectional broad-band source that will permit an assessment of reproducibility uncertainty in the determination of sound power level that is independent of source variability. The spectra for each source are displayed and discussed in sub-section 10.1. The approximate overall sizes of the three sources are shown in Table 1. Brief details of each noise source are given in sub-sections 3.1.1 to 3.1.3.

Table 1. Approximate machine dimensions.

Noise source	Dimensions (m)		
	Side-to-side	Front-to-back	Height
RSS	0.3	0.3	0.3
Generator	0.5	0.7	0.7
Box source	0.4	0.7	0.4

3.1.1 Reference Sound Source (RSS)

Manufacturer:	Brüel & Kjær, type: 4204
Power requirement:	240 volt, 50Hz mains

3.1.2 Diesel-engined electrical power generator (generator)

Manufacturer:	Lombardini (engine).
Type:	GLD360.
Manufacturer:	Markon Engineering (generator).
Type:	B31B.
Manufacturer:	Clarke Power (rectifier).
Power requirement:	diesel fuel, SAE grade 15/40 oil.

Some preparatory checks were advised; check the oil level using the dip-stick and top up as required and, if necessary, clean the air filter. The engine has a starting pull cord and instructions were given on its use. During measurements the engine was operated at the maximum power setting with the throttle lever fixed at its lowest position. Before commencing measurements the engine was allowed to run at this maximum power setting for 30 minutes.

3.1.3 Reference sound source in an MDF box (box source)

This noise source comprised a reference sound source fixed in a 0.4 m square section tube constructed of 0.02 m thick MDF material. The tube was 0.7 m long and orientated on its side with one end open and the other end closed using a 0.4 m square of 0.02 m thick MDF.

3.2 MEASUREMENTS ACCORDING TO ISO 3744

Measurements according to this standard must be carried out in a hemi-anechoic environment, or at least one where the environmental correction factor, K_2 is less than 2 dB. Descriptions of the test sites used by each Laboratory are given in Section 6.

Annex A of ISO 3744 describes methods of determining K_2 and states “For open test sites which consist of a hard, flat ground-surface, such as asphalt or concrete, and with no sound reflecting objects within a distance from the source equal to three times the greatest distance from the source centre to the lowest measurement points, it is assumed that the environmental correction K_2 is less than or equal to 0.5 dB and is, therefore, negligible.” It has been suggested¹², that this assumption may not be correct and that it is vitally important to determine K_2 for each measurement location. As well as providing data for noise sources with a low value of Directivity Index, the measurements carried out with the reference sound source are used (see Section 7) to estimate the value of K_2 .

Sound pressure levels were required to be measured with frequency weighting A and in one-third octave bands at mid-band frequencies from 50 Hz to 10 kHz, on the hemispherical measurement surfaces of radii listed in Table 2.

Table 2. Measurement radii, r , and characteristic dimension, d_0 .

Machine	r (m)	d_0 (m)
RSS	1.0	0.37
Generator	3.0	0.78
Box source	2.0	0.58

The number of measurement positions used for each hemispherical measurement surface was twenty. Each sound power level determination was repeated three times in order to assess measurement repeatability.

Sound power levels determined using this 20-microphone array were used as reference levels to which data from other arrays and configurations (see Sub-section 3.3) are compared and furthermore, are assumed to be true values. In fact the twenty microphone positions are formed from two sets of ten microphone positions each having a microphone directly over the machine at a height equal to the hemisphere radius, so this array actually has nineteen discrete positions.

The co-ordinates of the twenty microphone positions, described as a function of the hemisphere radius r , are listed in Table 3 in terms of their x, y and z co-ordinates (see Figure 1) the ten positions shown in Figure 1 are designated numbers 1 to 10 in Table 3.

In addition to the measured sound pressure level data each laboratory provided meteorological information and also measured the frequency of rotation of the reference sound source and the generator using a Brüel & Kjær type 4912 stroboscope.

Table 3 Co-ordinates of microphone positions according to ISO 3744

microphone position	x/r	y/r	z/r
1	-0.99	0	0.15
2	0.50	-0.86	0.15
3	0.50	0.86	0.15
4	-0.45	0.77	0.45
5	-0.45	-0.77	0.45
6	0.89	0	0.45
7	0.33	0.57	0.75
8	-0.66	0	0.75
9	0.33	-0.57	0.75
10	0	0	1.0
11	0.99	0	0.15
12	-0.50	0.86	0.15
13	-0.50	-0.86	0.15
14	0.45	-0.77	0.45
15	0.45	0.77	0.45
16	-0.89	0	0.45
17	-0.33	-0.57	0.75
18	0.66	0	0.75
19	-0.33	0.57	0.75
20	0	0	1.0

3.3 SPATIAL SAMPLING

From the sound pressure level measurements made using the twenty microphone positions listed in Table 3, values of sound power level may be calculated for several microphone position sub-sets. Initially, seven microphone position sub-sets were used, each sub-set is described in the following list using the ISO 3744 microphone position numbers from Table 3.

- Twenty positions The key and additional positions of ISO 3744

One array	
Positions	1 to 20

 - Ten positions The 10-key positions of ISO 3744 and the 10-additional positions of ISO 3744

Two arrays	
Positions	1, 2, 3, 4, 5, 6, 7, 8, 9 and 10 11, 12, 13, 14, 15, 16, 17, 18, 19 and 20

 - Six positions Six positions on each of the three complete hemispherical arcs

Three arrays	
Positions	12, 4, 19, 9, 14 and 2 3, 15, 7, 17, 5, and 13 11, 6, 18, 9, 16 and 1
- In the results Sections of this Report these arrays are described as 6 (opp)
- Four positions All four positions at different heights

Six arrays	
Positions	1, 15, 9 and 20 12, 6, 17 and 20 3, 14, 8 and 20 11, 5, 19 and 20 2, 16, 7 and 20 13, 4, 18 and 20

- Three positions All three positions at different heights

Six arrays

Positions 1, 14 and 7
 12, 6 and 17
 3, 14 and 8
 11, 5 and 19
 2, 16 and 7
 13, 4 and 18

In the results Sections of this Report these arrays are described as 3 (120)

- Three positions Three positions, two on one half-hemispherical arc and one on the opposite half-hemispherical arc

Six arrays

Positions 3, 7 and 5
 11, 18 and 16
 2, 9 and 4
 13, 17 and 15
 1, 8 and 6
 12, 19 and 14

In the results Sections of this Report these arrays are described as 3 (opp)

- One position Each of the twenty ISO 3744 positions

Twenty arrays

Positions individually, 1 through 20

4. CALCULATION OF UNCERTAINTIES

Values of uncertainty for sound power level determinations obtained using the 20-microphone array have been calculated using the procedures described in ISO 57252:1994¹⁰. This Standard describes the method for calculating the repeatability and reproducibility from inter-laboratory experiments. The reproducibility variance, S_R^2 is given by:

$$S_R^2 = S_r^2 + S_L^2$$

where,

S_r^2 is the repeatability variance, which is the average taken over all the laboratories, of all the variances calculated for a particular set of repeatability conditions,

S_L^2 is the between-laboratory variance, which is the variance of test results that are constant under repeatability conditions, but differ with equipment and operators.

The repeatability variance S_r^2 is given by:

$$S_r^2 = \frac{\sum_{i=1}^p (n_i - 1) S_i^2}{\sum_{i=1}^p (n_i - 1)}$$

where,

n_i is the number of repeat measurements carried out by Laboratory i ,

p is the number of Laboratories,

S_i^2 is the variance of the three repeat measurements carried out by each laboratory.

The between-laboratory variance, S_L^2 is given by:

$$S_L^2 = \frac{S_d^2 - S_r^2}{n}$$

where,

$$\bar{n} = \frac{1}{(p-1)} \left(\sum_{i=1}^p n_i - \frac{\sum_{i=1}^p n_i^2}{\sum_{i=1}^p n_i} \right)$$

and S_d^2 is obtained from:

$$S_d^2 = \frac{1}{(p-1)} \left(\sum_{i=1}^p n_i (\bar{y}_i)^2 - (\bar{\bar{y}})^2 \sum_{i=1}^p n_i \right)$$

where,

$$\bar{\bar{y}} = \frac{\sum_{i=1}^p n_i \bar{y}_i}{\sum_{i=1}^p n_i}$$

Values of S_R^2 have also been calculated for each of the sub-sets listed in Sub-section 3.3. For these calculations the value of n_i is the number of repeat determinations multiplied by the number of sub-sets. For instance, assuming three repeats, then for the four position sub-sets the value of n_i will be 18. This value of S_R^2 is a measure of the variability of data from each individual sound power determination of the sub-set about the mean for that sub-set. For instance, for the four position sub-set, this will involve the standard deviation of the six sound power determinations about the mean of the six determinations. From this value an assessment can be made of how similar to the mean value estimates from a single four microphone determination are likely to be.

However, this does not allow an assessment as to the accuracy of the determination. All six determinations (and therefore, the mean value) may be in error. To account for this possibility it is assumed that the sound power level calculated using all 20 microphone positions is correct (the true level) and a standard deviation about this value is calculated. This value permits an assessment of how similar to the true value estimates of sound power level from a single four microphone determination are likely to be. This standard deviation is essentially a combination of the variability of a single sub-set sound power determination and the difference between the mean of all sub-set combinations and the true value.

4.1 THE IMPORTANCE OF MEASUREMENT UNCERTAINTY

As discussed in Section 1, a new EC Directive is soon to come into force that concerns the noise emitted by machinery for use outdoors. This new Directive requires the manufacturer to label each machine with a guaranteed sound power level, and it is this guaranteed level that will be used to determine compliance with noise limits. This guaranteed level is obtained by adding a correction to the measured value to account for both measurement uncertainty and, for high volume production, an allowance for production variations. Corrections arising from production variations will not be considered in this report. The magnitude of the correction arising from measurement uncertainty is dependent on the particular procedure used in the measurement and will involve defining several statistical parameters. Values of measurement uncertainty are listed in all B-type Standards. For a Grade 2 accuracy method (e.g., the ISO 3744 ten measurement position array), it is estimated to be approximately 1.5 dB whilst for Grade 3 accuracy (e.g., the ISO 3746 four measurement position array), it is estimated to be between 3 dB and 4 dB depending on the type of machine. For C-type Standards, values are not generally given but they may be inferred from the appropriate framework B-type Standard.

The statistical procedures of ISO 4871⁹ may be followed for the purposes of declaration and verification of noise levels. This Standard assumes a generally accepted specific set of statistical parameters in conjunction with the measurement uncertainty to ensure that the correction to be applied is such that verification procedures ensure that there is a 95% probability of acceptance, and in addition, for the case of batch testing, no more than 6.5% of the sound power levels in a batch will exceed the labelled value. An accurate assessment of the measurement uncertainty is therefore of prime importance as it will have a direct effect on the labelled value. If there are limits it is this labelled value, not the measured value, that must not exceed the limit. Therefore, there may be cases where it is also important to ensure that the value of measurement uncertainty is small. This may to some extent dictate the method used to determine the sound power.

5. EXPERIMENTAL INSTRUMENTATION

There is an inherent requirement for all instrumentation to adhere to the specifications described in ISO 3744. All organisations showed compliance and provided evidence of calibration certificates where required. The equipment used by each organisation, as supplied in their measurement reports, is listed below.

5.1 EQUIPMENT USED BY LABORATORY 1

Real time frequency analyser	Brüel & Kjær; type 2144
Half-inch condenser microphone	Brüel & Kjær; type 4165
Half-inch microphone preamplifier	Brüel & Kjær; type 2639
Microphone power supply	Vinculum type; M591
Sound level calibrator	Brüel & Kjær; type 4228
Multi-frequency calibrator	Brüel & Kjær; type 4226

5.2 EQUIPMENT USED BY LABORATORY 2

Sound analyser	Norsonic; type 110
Microphone	Norsonic; type 1220
Microphone pre-amplifier	Norsonic; type 1201
Calibrator	Norsonic; type 1253

5.3 EQUIPMENT USED BY LABORATORY 3

Microphone	CEL; type 192/2F
Microphone pre-amplifier	CEL; type 527
Pre-amplifier extension cable	CEL; type C6615
Calibrator	CEL; type 284/2
Sound level meter	CEL; type 573.C1R/2M

5.4 EQUIPMENT USED BY LABORATORY 4

Real-time analyser	Brüel & Kjær; type 2144
Half-inch condenser microphone	Brüel & Kjær; type 4165
Half-inch microphone preamplifier	Brüel & Kjær; type 2639
Calibrator	Brüel & Kjær; type 4230

6. MEASUREMENT LOCATIONS

The acoustic environment is specified in ISO 3744 and is briefly outlined below together with a short description of the experimental locations used by each laboratory.

6.1 ISO 3744 MEASUREMENT LOCATION REQUIREMENTS

The test environment that is applicable for measurements made in accordance with this International Standard is an essentially free field near one or more reflecting planes (indoors or outdoors). As far as practicable, the test environment shall be free from reflecting objects other than a reflecting plane so that the source radiates into a free field over a reflecting plane. The standard describes methods to determine the environmental correction factor, K_2 . For measurements made strictly according to ISO 3744, K_2 must be numerically less than or equal to 2 dB.

6.1.1 Location used by Laboratory 1

An outdoor measurement location was used for all measurements on the three noise sources. The location consisted of a large flat surface covered with sealed asphalt approximately 30 m square with no sound-reflecting obstructions.

6.1.2 Locations used by Laboratory 2

All measurements were carried out on a purpose built concrete noise test pad. The pad area was 25 m square with an adjoining concrete access road and surrounded by a flat grass area with no reflecting obstructions for a further 20 m beyond the limits of the concrete surface.

6.1.3 Locations used by Laboratory 3

All measurements were carried out on a tarmacadam road surface. The surface was surrounded on three sides by grass area at least 15 m wide and by a 2 m wide strip backed by trees on the fourth side. The distance from the centre of the measurement hemispherical surface to the nearest grass area was 10 m.

6.1.4 Locations used by Laboratory 4

Measurements on all three noise sources were undertaken in a car park on three essentially similar adjacent locations. The nearest sound-reflecting object (motor vehicles on three sides and a 1.5 m high wall on the fourth) was a minimum of 11 m from the centre of each hemispherical measurement surface.

7. A-WEIGHTED SOUND POWER LEVEL DETERMINATIONS

The operating conditions of the noise sources are not those required for testing to the various EC Directives and so sound power levels cannot be compared with those carried out in accordance with their requirements. In any case, the absolute sound power levels are not of interest for the purposes of this report, only differences resulting from the measurement configuration and between each Laboratory's determination. So, all sound power levels in this report are expressed with a zero area correction.

The measurement programme described in Section 3 was carried out by all four Laboratories at their own measurement sites. The three repeat measurements enabled an estimation of each laboratory's repeatability uncertainties for each sound power determination. All the sound pressure levels measured at each of the twenty microphone positions detailed in Table 1 are listed in Appendix 1.

In addition, measurements were carried out by one of the Laboratories at all four measurement locations at a time as close as practicable to the time measurements were made by each individual Laboratory. These measurements were performed to check on the long term stability of the noise sources and also permitted an estimation of uncertainties associated with the differing measurement sites. These uncertainties are a half way house between repeatability- and reproducibility-conditions and should provide information as to the contribution of variations resulting from differing sites and differing measurement laboratories to the final reproducibility variance. In this report we refer to these uncertainties as "intra-site repeatability".

Finally standard deviations of reproducibility uncertainties have been calculated as described in Section 4 for each of the spatial sampling microphone array sub-sets listed in sub-section 3.3.

Reproducibility and intra-site uncertainties have been estimated using the as measured data and data corrected to allow for differences in environmental correction factor, K_2 , as indicated by the differences in sound power determinations using the reference sound source. These latter estimates may be considered as approximate as the requirements of ISO 3744 regarding the measurement of K_2 have not been strictly followed as the standard requires that the sound power of the reference sound source is estimated using the same array as used for the noise source under investigation. However, if the radius of the hemispherical enveloping surface is greater than approximately three times the largest source dimension, the determined sound power level may be considered independent of the hemisphere radius¹². This is the case for the measurements carried out here, so the values of K_2 may be considered as reasonable estimates.

7.1 MEASURED NOISE SOURCE PARAMETERS.

7.1.1 Frequency of rotation

As discussed in sub-section 3.2 each laboratory provided meteorological information and also measured the frequency of rotation of the reference sound source and the generator using a Brüel & Kjær; type 4192 stroboscope. The frequency of rotation of the reference sound source

ranged from 47.9 Hz to 48.1 Hz. Although this variation is small the manufacturer suggests a potential variation in A-weighted sound power level of 0.1 dB. For the generator the frequency of rotation varies from 52.6 Hz to 53.1 Hz. It is not clear what effect this variation will have on the A-weighted sound power level but some supplementary measurements indicate that they are encompassed by the repeatability associated with the determination of sound power.

7.1.2 Temperature variations.

The maximum ambient temperature variation during a series of measurements carried out by an individual Laboratory was 4 °C. The range of temperatures between measurements made at each Laboratory varied from 9 °C for the reference sound source to 4 °C for the generator and box source. For the reference sound source the manufacturer quotes a change in sound power level ΔL dB due to variations in ambient temperature as:

$$\Delta L = 5 \log (T_{cal}/T),$$

where, T_{cal} is the temperature at the time of calibration and T is the ambient temperature, both in kelvin. For the purposes of this series of measurements, T_{cal}/T corresponds to the maximum temperature divided by the minimum temperature.

Using this expression the maximum value of ΔL for the measurements carried out by all Laboratories (corresponding to a temperature change of 9 °C) is only 0.06 dB.

7.1.3 Directivity Index

The Directivity Index of each noise source was estimated from data supplied by each Laboratory for the 20-microphone array using:

$$\text{Directivity Index} = L_p - L_{pm}$$

where, L_p is the maximum of the sound pressure levels measured at the 20 positions, and L_{pm} is the surface sound pressure level for an enveloping hemisphere radius r .

There was some variation between the values calculated from the data supplied by each Laboratory and so average values have been calculated and these are shown together with actual values in Tables 4a, 4b and 4c for the reference sound source, the generator and the box source respectively.

Table 4a Directivity Index (dB) for the reference sound source

Frequency band (Hz)	Laboratory				mean
	1	2	3	4	
A-wt	0.86	0.85	0.81	0.63	0.79
50	1.79	2.05	2.31	2.49	2.16
63	1.66	1.74	2.33	2.12	1.96
80	2.06	2.66	2.33	1.71	2.19
100	2.12	1.66	2.10	1.73	1.90
125	1.45	1.73	2.18	1.78	1.78
160	1.58	1.93	2.40	2.11	2.00
200	2.13	1.97	2.00	2.05	2.04
250	2.36	2.20	2.26	2.07	2.22
315	2.43	2.38	2.39	2.33	2.38
400	2.60	2.85	2.79	2.66	2.72
500	3.00	3.05	3.27	2.94	3.06
630	2.65	2.67	2.96	2.66	2.74
800	2.47	2.31	2.53	2.29	2.40
1000	2.37	1.73	2.42	2.11	2.16
1250	1.88	1.17	2.24	1.79	1.77
1600	2.71	2.52	2.19	1.21	2.16
2000	2.50	1.57	1.38	2.73	2.04
2500	1.74	1.47	1.44	1.74	1.60
3150	2.20	2.50	2.86	3.10	2.66
4000	1.91	1.66	1.66	2.89	2.03
5000	2.12	2.14	2.26	1.96	2.12
6300	1.80	1.86	2.14	1.41	1.80
8000	1.35	1.65	1.56	1.78	1.59
10000	1.14	1.63	1.15	1.41	1.33

Table 4b Directivity Index (dB) for the generator

Frequency band (Hz)	Laboratory				mean
	1	2	3	4	
A-Wt	1.16	1.32	1.23	1.46	1.30
50	3.71	1.06	1.01	2.19	1.99
63	3.41	1.38	1.05	2.24	2.02
80	2.79	4.08	3.97	5.30	4.04
100	2.16	3.16	3.73	3.18	3.06
125	3.23	2.83	2.23	3.01	2.82
160	4.69	4.97	4.96	5.00	4.91
200	7.13	6.71	6.25	7.17	6.81
250	5.90	6.94	6.64	5.73	6.30
315	3.90	3.87	2.40	4.66	3.71
400	4.17	5.87	4.36	2.64	4.26
500	1.91	2.07	2.05	2.72	2.19
630	3.62	4.43	3.97	3.44	3.86
800	4.15	3.86	2.83	4.08	3.73
1000	2.69	3.20	2.47	3.58	2.99
1250	2.41	2.40	2.16	3.14	2.53
1600	2.21	2.54	2.81	3.86	2.86
2000	3.32	3.43	3.23	4.67	3.66
2500	2.73	2.64	3.07	4.38	3.21
3150	2.28	2.30	1.97	4.94	2.87
4000	2.25	2.75	2.01	4.63	2.91
5000	2.08	2.57	2.13	2.22	2.25
6300	2.55	2.82	2.31	3.68	2.84
8000	2.37	3.04	1.70	2.25	2.34
10000	3.22	2.90	3.45	3.09	3.16

Table 4c Directivity Index (dB) for the box source

Frequency band (Hz)	Laboratory				mean
	1	2	3	4	
A-wt	6.63	6.85	6.89	7.10	6.87
50	3.38	4.44	3.65	6.11	4.40
63	4.55	2.99	3.32	6.25	4.28
80	3.69	3.58	3.66	4.29	3.81
100	3.91	3.96	3.82	3.41	3.78
125	4.18	4.23	4.39	4.46	4.32
160	4.16	4.39	4.43	4.38	4.34
200	5.69	5.89	5.77	5.68	5.76
250	6.38	6.50	6.51	6.51	6.48
315	7.69	7.52	7.32	7.62	7.54
400	6.91	7.37	7.00	6.86	7.03
500	7.01	7.66	7.80	7.37	7.46
630	8.29	8.67	8.38	8.50	8.46
800	9.07	9.81	9.41	9.51	9.45
1000	8.10	8.09	8.43	8.66	8.32
1250	7.91	7.43	7.69	7.86	7.72
1600	7.60	8.74	8.84	7.85	8.26
2000	7.93	7.54	7.20	7.33	7.50
2500	6.98	6.96	7.38	6.23	6.89
3150	6.93	7.07	7.22	7.79	7.25
4000	6.57	7.21	7.62	7.36	7.19
5000	6.78	7.43	7.51	6.60	7.08
6300	6.73	7.17	6.98	7.25	7.03
8000	6.61	7.17	7.35	6.94	7.02
10000	6.55	7.00	6.91	7.31	6.94

7.2 REPEATABILITY UNCERTAINTIES

The A-weighted repeatability uncertainties for each Laboratory together with mean values are shown in Tables 5a, 5b and 5c for the reference sound source, the generator and the box source respectively.

Table 5a Standard deviations of repeatability uncertainties (expressed in dB) for the reference sound source.

Laboratory	Number of measurement positions						
	20	10	6 (opp)	4	3 (opp)	3 (120)	1
1	0.08	0.08	0.09	0.15	0.13	0.12	0.24
2	0.05	0.05	0.06	0.05	0.06	0.06	0.09
3	0.01	0.02	0.03	0.05	0.05	0.06	0.07
4	0.01	0.01	0.02	0.02	0.02	0.02	0.04
mean	0.04	0.04	0.05	0.07	0.07	0.07	0.11

Table 5b Standard deviations of repeatability uncertainties (expressed in dB) for the Generator.

Laboratory	number of measurement positions						
	20	10	6 (opp)	4	3 (opp)	3 (120)	1
1	0.00	0.08	0.08	0.07	0.14	0.11	0.20
2	0.10	0.09	0.12	0.09	0.14	0.14	0.18
3	0.02	0.03	0.05	0.04	0.07	0.04	0.10
4	0.02	0.02	0.03	0.05	0.04	0.03	0.07
Mean	0.04	0.06	0.07	0.06	0.10	0.08	0.14

Table 5c Standard deviations of repeatability uncertainties (expressed in dB) for the box source.

Laboratory	Number of measurement positions						
	20	10	6 (opp)	4	3 (opp)	3 (120)	1
1	0.11	0.16	0.15	0.30	0.32	0.32	0.35
2	0.05	0.05	0.10	0.09	0.11	0.10	0.14
3	0.05	0.06	0.09	0.09	0.11	0.10	0.08
4	0.03	0.04	0.05	0.05	0.05	0.05	0.08
Mean	0.06	0.08	0.10	0.13	0.15	0.14	0.16

It can be seen that there is some variation between Laboratories but values for all three noise sources tend to increase as the number of microphone positions is reduced. However, it can be seen that this increase is only of the order 0.1 dB when the number of microphones is reduced from twenty to one. This is an indication that the random variations in sound pressure level at an individual microphone location are smoothed out when the output of a number of microphone outputs are averaged. An examination of the mean values shows that repeatability uncertainties are generally less than 0.2 dB and for the reference 20-microphone array are of the order 0.05 dB.

7.3 CALCULATED A-WEIGHTED INTRA-SITE UNCERTAINTIES.

The average of the three repeat A-weighted sound power levels, expressed in dB, determined by one Laboratory using the 20-microphone array at each site for each sound source are shown in Table 6.

Table 6 Average sound power levels (dB) used to calculate intra-site repeatability uncertainties

Source	Site used by Laboratory number			
	1	2	3	4
RSS	84.02	84.04	83.65	83.45
Generator	87.42	87.31	86.74	86.81
Box source	75.65	75.82	75.30	74.88

It can be seen that there is a variation in sound power determination between sites, with a range of 0.59 dB, 0.68 dB and 0.94 dB for the reference sound source, generator and box source respectively. If it is assumed that the variations in sound power level for the reference sound source are the result of differing values of K_{2A} then data may be corrected relative to the site 1 value by adding -0.02 dB, 0.37 dB and 0.57 dB to the site 2, site 3 and site 4 values respectively. Then the range of the variation in sound power determinations for the generator is reduced to 0.31 dB and for the box source to 0.35 dB. These variations (for the 20-microphone array) are shown in Table 7 as standard deviations of intra-site uncertainty together with values calculated for the various microphone arrays listed in sub-section 3.3. The Table contains standard deviations about individual sub-set means and about the 20-microphone mean value (see Section 4) for the as measured sound powers and for the values corrected for K_{2A} .

Data in italics are calculated relative to the 20-microphone array mean sound power levels and data in shaded areas are calculated after applying K_{2A} corrections.

Table 7 Values of A-weighted intra-site repeatability uncertainty expressed in dB

	number of microphones in the array						
source	20	10	6 (opp)	4	3 (opp)	3 (120)	1
RSS	0.29	0.29	0.32	0.34	0.31	0.33	0.73
<i>RSS</i>	<i>0.29</i>	<i>0.29</i>	<i>0.35</i>	<i>0.42</i>	<i>0.33</i>	<i>0.36</i>	<i>0.73</i>
Generator	0.35	0.38	0.41	0.37	0.46	0.42	1.15
<i>Generator</i>	<i>0.35</i>	<i>0.38</i>	<i>0.42</i>	<i>0.39</i>	<i>0.47</i>	<i>0.42</i>	<i>1.16</i>
Generator	0.15	0.21	0.24	0.24	0.32	0.36	1.11
<i>Generator</i>	<i>0.15</i>	<i>0.21</i>	<i>0.25</i>	<i>0.26</i>	<i>0.33</i>	<i>0.43</i>	<i>1.12</i>
Box source	0.42	0.52	2.38	1.51	2.33	1.61	5.80
<i>Box source</i>	<i>0.42</i>	<i>0.52</i>	<i>2.41</i>	<i>1.81</i>	<i>2.42</i>	<i>1.61</i>	<i>7.30</i>
Box source	0.14	0.35	2.35	1.46	2.29	1.61	5.79
<i>Box source</i>	<i>0.14</i>	<i>0.35</i>	<i>2.37</i>	<i>1.77</i>	<i>2.37</i>	<i>1.61</i>	<i>7.30</i>

It can be seen from Table 7 that for the 20-microphone array, standard deviations of intra-site repeatability of 0.29 dB, 0.35 dB and 0.42 dB were obtained for the reference sound source, the generator and the box source respectively. When the sound power levels are corrected to account for differences in measured values of K_{2A} then the standard deviations for the generator and the box source are reduced to 0.15 dB and 0.14 dB respectively (a reduction of 0.2 dB and 0.28 dB). It is clear that, for the 20-microphone array, although the four sites used were all in the category described in ISO 3744 that may be considered as having values of K_{2A} that may be neglected, an adjustment for the actual values of K_{2A} reduces the measurement uncertainty.

It is interesting to compare these values of intra-site repeatability with the repeatability data shown in Tables 5a, 5b and 5c where standard deviations of 0.04 dB, 0.04 dB and 0.06 dB were obtained for the reference sound source, the generator and the box source respectively. This comparison indicates that there is a residual contribution to the measurement uncertainty of approximately 0.1 dB that cannot be attributed to variations in the value of K_{2A} . This residual uncertainty is small and similar to the standard deviations of repeatability. It must be remembered that values of K_{2A} were obtained by measurements carried out using the reference sound source and so sound power determinations are also subject to the repeatability measurement uncertainties and so the “residual contribution” is unlikely to be statistically significant.

Variations of repeatability uncertainties were observed (see Tables 5a, 5b and 5c) to increase slightly (of the order 0.1 dB) as the number of microphones used in the measurement array is reduced from twenty to one. It can be seen from Table 7 that the standard deviations of intra-site repeatability show a marked increase as the number of measurement positions is reduced to one. The magnitude of this increase in value is dependent on the noise source, being smallest for the reference sound source and largest for the box source. In fact, the increase is dependent on the directivity index of the source which is largest for the box source (6.9 dB) and smallest for the reference sound source (0.8 dB) and 1.3 dB for the generator.

It can also be seen from Table 7 that for the reference sound source and the generator, the standard deviations of intra-site repeatability are essentially independent of the number of microphone positions until this is reduced to a single microphone. Clearly a sound power determination using a single microphone location is associated with a high value of measurement uncertainty. However, for the box source, that has a large directivity index, there is a significant increase in the value of the standard deviation when the number of microphones is reduced below ten with a very large increase for a single microphone.

Apart from the single microphone result for the box source, the standard deviations calculated using the sub-set means are similar to those calculated using the appropriate 20-microphone array sound power levels, indicating that the two mean values are similar. For these cases the standard deviations are the result of variations between individual sub-sets and not of an overall under- or over-estimate of the sound power level. The converse is true for the single microphone estimate for the box source.

It can be seen that, with the exception of the 20-microphone array and, to a lesser extent, the 10-microphone array, the effect on the standard deviations of correcting measured data to account for variations in K_{2A} is negligible.

It is clear that once the number of microphones is reduced below ten, the major contribution to intra-site repeatability is from variations in sound power determination resulting from inadequate spatial sampling with minimal contribution from repeatability uncertainties (see Tables 5a, 5b and 5c) and from variations resulting from using different measurement sites.

7.4 CALCULATED A-WEIGHTED REPRODUCIBILITY UNCERTAINTIES.

The average of the three repeat A-weighted sound power levels, expressed in dB, determined

by each Laboratory using the 20-microphone array at their own site for each sound source are shown in Table 8.

Table 8 Average sound power levels (dB) used to calculate standard deviations of reproducibility uncertainties

	Laboratory			
Source	1	2	3	4
RSS	83.92	83.38	84.19	83.85
Generator	87.42	87.01	87.67	86.67
Box source	75.74	75.22	75.75	75.43

It can be seen that there is a variation in sound power determination between Laboratories, with a range of 0.81 dB, 1.0 dB and 0.53 dB for the reference sound source, generator and box source respectively. These variations are similar to the intra-site values in Table 6, with the range for the reference sound source and the generator slightly larger and for the box source, perhaps surprisingly, slightly smaller. If it is assumed that the variations in sound power level for the reference sound source are the result of differing values of K_{2A} then data may be corrected relative to the Laboratory 1 value by adding 0.54 dB, -0.27 dB and 0.07 dB to the Laboratory 2, Laboratory 3 and Laboratory 4 values respectively. Then the range of the variation in sound power determinations for the generator is reduced to 0.81 dB and for the box source to 0.28 dB, a reduction of 0.19 dB and 0.25 dB. These reductions are similar to those found for the intra-site repeatability and again indicate that, for the 20-microphone array, a correction for K_{2A} produces a smaller measurement uncertainty.

These variations for the 20-microphone array are shown in Table 9 as standard deviations of reproducibility uncertainty together with values calculated for the various microphone arrays listed in sub-section 3.3. The Table contains standard deviations about individual sub-set means and about the 20-microphone mean value (see Section 4) for the as measured sound powers and for the values corrected for K_{2A} .

Data in italics are calculated relative to the 20-microphone array mean sound power levels and data in shaded areas are calculated after applying K_{2A} corrections. For the lighter shaded areas values of K_{2A} are those determined for measurements made on the reference sound source by Laboratory 1 at each measurement site and for the darker shaded areas values of K_{2A} are those determined from measurements on the reference sound source made by each individual Laboratory at their own site.

It can be seen from a comparison of these data with those in Table 7 that the reproducibility standard deviations are very similar to those for intra-site repeatability. In fact, the data are so similar that all the observations discussed in sub-section 7.3 on intra-site repeatability may be repeated for these reproducibility standard deviations.

Table 9 Values of A-weighted reproducibility uncertainty expressed in dB

	number of microphones in the array						
source	20	10	6 (opp)	4	3 (opp)	3 (120)	1
RSS	0.34	0.34	0.34	0.36	0.35	0.35	0.64
<i>RSS</i>	<i>0.34</i>	<i>0.34</i>	<i>0.37</i>	<i>0.40</i>	<i>0.38</i>	<i>0.37</i>	<i>0.64</i>
Generator	0.44	0.48	0.44	0.54	0.49	0.46	1.11
<i>Generator</i>	<i>0.44</i>	<i>0.48</i>	<i>0.44</i>	<i>0.54</i>	<i>0.49</i>	<i>0.46</i>	<i>1.12</i>
Generator	0.15	0.21	0.24	0.24	0.32	0.36	1.11
<i>Generator</i>	<i>0.15</i>	<i>0.21</i>	<i>0.25</i>	<i>0.26</i>	<i>0.33</i>	<i>0.43</i>	<i>1.12</i>
Generator	0.37	0.41	0.40	0.44	0.45	0.41	1.08
<i>Generator</i>	<i>0.37</i>	<i>0.41</i>	<i>0.40</i>	<i>0.44</i>	<i>0.45</i>	<i>0.41</i>	<i>1.09</i>
Box source	0.26	0.42	2.39	1.60	2.59	1.69	5.91
<i>Box source</i>	<i>0.26</i>	<i>0.42</i>	<i>2.42</i>	<i>1.91</i>	<i>2.64</i>	<i>1.69</i>	<i>7.49</i>
Box source	0.42	0.52	2.41	1.63	2.60	1.72	5.92
<i>Box source</i>	<i>0.42</i>	<i>0.53</i>	<i>2.44</i>	<i>1.93</i>	<i>2.65</i>	<i>1.72</i>	<i>7.50</i>
Box source	0.16	0.37	2.39	1.59	2.58	1.69	5.91
<i>Box source</i>	<i>0.16</i>	<i>0.37</i>	<i>2.42</i>	<i>1.91</i>	<i>2.63</i>	<i>1.69</i>	<i>7.48</i>

The conclusion that may be drawn from this similarity between intra-site and repeatability data is, that when several Laboratories carry out a sound power determination using a specified procedure, the measurement uncertainties involved are not statistically significantly different from those associated with measurements carried out by a single Laboratory so the major contributor to measurement uncertainty are variations resulting from differing site conditions.

Although the value of reproducibility standard deviations is dependent on the number of microphones in the array, it can be seen from the data for the two 3-microphone arrays for the highly directional box source, that it is also dependent on the distribution of the microphones. To examine this further, a third 3-microphone array has been assumed (3 (same)) in which all three microphones are on the same half-hemispherical arc. This microphone sub-set is described in the following list using the ISO 3744 microphone position numbers from Table 3.

Three positions Three positions on the same one half-hemispherical arc

Six arrays

Positions 3, 15 and 7
 11, 6, and 18
 2, 14 and 9
 13, 5 and 17
 1, 16 and 8
 12, 4 and 19

Here the A-weighted reproducibility standard deviation relative to the 20-microphone sound power level, uncorrected for K_{2A} , was found to be 7.1 dB. So, a 3-microphone array may be associated with reproducibility standard deviations of 1.69 dB, 2.64 dB or 7.1 dB depending on the distribution of the microphones over the measurement surface. It is clear, therefore, that for the purposes of estimating levels of reproducibility uncertainty, a knowledge of only the number of microphones is not sufficient.

In Section 1 it was stated that an objective of this current series of measurements was to assess the suitability of measurement uncertainties based on repeatability data estimated from a previous study⁸ with regard to their inclusion in a new series on international standards. So, it is important at this stage to compare these standard deviations of reproducibility with the corresponding data from reference 8. Reference 8 has values of standard deviations for the 1-, 3 (opp)-, 4- and 6-microphone arrays for the three sound sources. Results (using the 20-microphone array data as mean values) from reference 8 (Ref 8) are listed in Table 10 together with the reproducibility standard deviations from the current measurements (new).

Table 10 Comparison of standard deviations of reproducibility with data based on repeatability uncertainty from Reference 8

	NUMBER OF MICROPHONES							
	6 (opp)		4		3 (opp)		1	
	DATA SOURCE							
	SOURCE	Ref 8	new	Ref 8	new	Ref 8	new	Ref 8
RSS	0.54	0.37	0.27	0.4	0.18	0.38	0.77	0.64
Generator	1.13	0.44	0.34	0.54	0.57	0.49	1.23	1.12
Box source	3.67	2.42	2.65	1.91	3.57	2.64	6.12	7.49

It can be seen that the standard deviations of reproducibility calculated from sound power levels determined from the round-robin exercise described in this report are similar to the measurement uncertainties from reference 8. In fact, values from Reference 8 are generally larger than the reproducibility data from this Report. It is concluded therefore that for A-weighted sound power levels, standard deviations of reproducibility based on data from reference 8 may over-estimate actual values and so considering the application of measurement uncertainties in providing a guaranteed sound power level will be suitable for

inclusion in international sound power standards.

In Reference 8 it was concluded that, as the noise source becomes more directional (i.e. the Directivity Index increases) the measurement uncertainty involved with a given sound power determination procedure increases and for a given noise source the measurement uncertainty increases as the number of microphones used in the sound power determination decreases. Whilst this latter conclusion is generally correct, the measurement uncertainty is also dependent on the distribution of the microphones. So, it is possible for an array with say three microphones to be associated with a smaller measurement uncertainty than one that uses six microphones (see for example Table 7 for the 3- and 6-microphone arrays). In order to assess the effects of microphone distribution further, the data of Reference 8 has been re-analysed to include the three 3-microphone arrays (two from sub-section 3.3 and the one described above) used in this current series of measurements and two 6-microphone arrays, one from sub-section 3.3 and the other (6 (120)) described in the following list using the ISO 3744 microphone position numbers from Table 3.

Six positions Using all three heights with two positions at the same height on opposite sides on each of the three complete hemispherical arcs

Three arrays

Positions 1, 11, 4, 14, 7, and 17
 12, 2, 15, 5, 18 and 8
 3, 13, 6, 16, 9 and 19

In addition, to complete the series of feasible arrays, a seven position array has also been considered. Here, there are three arrays that use the same measurement positions as for the six-microphone array above with the addition of the overhead position, number 20.

The standard deviations of reproducibility for all sub-sets from sub-section 3.3 and the extra 3-, 6- and 7-microphone sub-sets described in this sub-section are shown in the following nine displays, numbered Figure 2a to 2i, plotted as a function of Directivity Index with one display for each microphone sub-set considered. For comparison purposes, the reproducibility scale has been adjusted so that 1 dB has the same physical magnitude in each of the nine Figures. A least squares linear best fit line has been fitted to each data set (the solid line). As an indication as to the goodness of fit the standard deviation (s.d.) of the differences of each data point from this line has been calculated. The best fit lines are of the form $y = mx + C$. The constants “m” and “C” are listed in Table 11 together with the associated standard deviation (s.d.).

In order to take account of the variations of the reproducibility uncertainty values about these best fit lines, it is interesting to consider the goodness of fit of the data points by the use of the standard deviation of the differences of individual data points to the best fit line (see Table 11). The effect of these standard deviations is shown in Figures 2a to 2i, where twice the standard deviation has been added to, and taken from, the constant C thus providing two (dashed) lines representing a $\pm$ two standard deviation limit. Statistically, this means that 95% of data points would be expected to lie within these two lines. An examination of the nine figures tends to bear this out.

Table 11 Constants and standard deviations for best fit lines

No of microphones	m	C	s.d. (dB)
10	0.02511	0.14545	0.23
7	0.12263	- 0.02798	0.20
6 (120)	0.36070	- 0.48852	0.65
6 (opp)	0.52600	- 0.54931	0.65
4	0.36059	- 0.33439	0.25
3 (120)	0.48180	- 0.42535	0.58
3 (0pp)	0.50006	- 0.43811	0.49
3 (same)	0.78211	- 0.79589	1.22
1	0.88264	- 0.33954	0.85

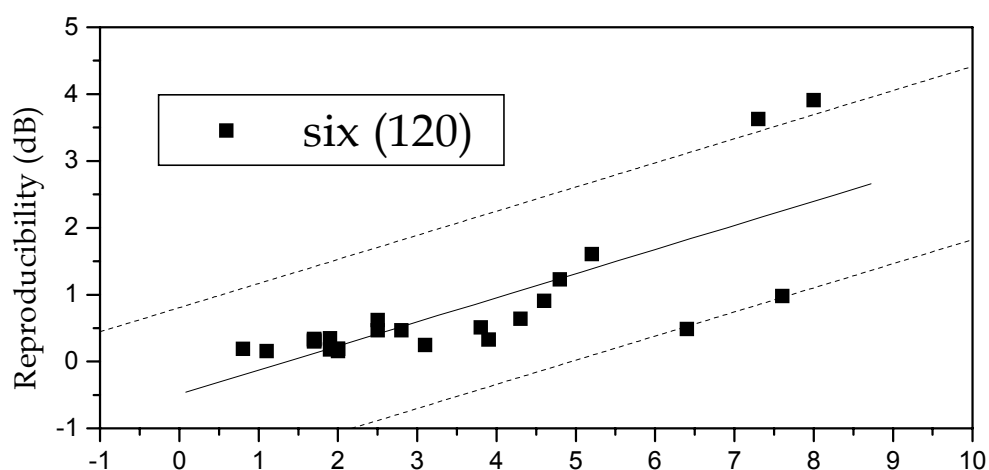
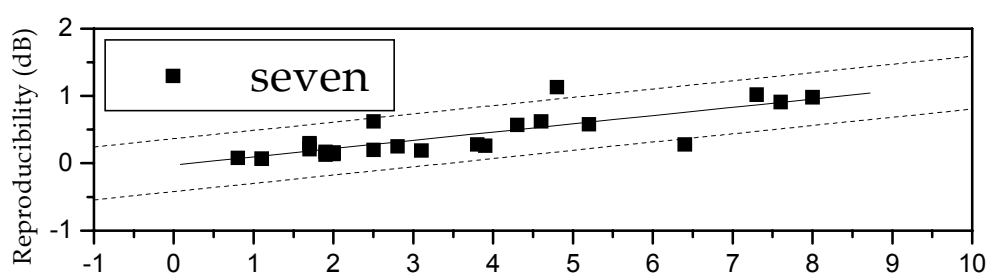
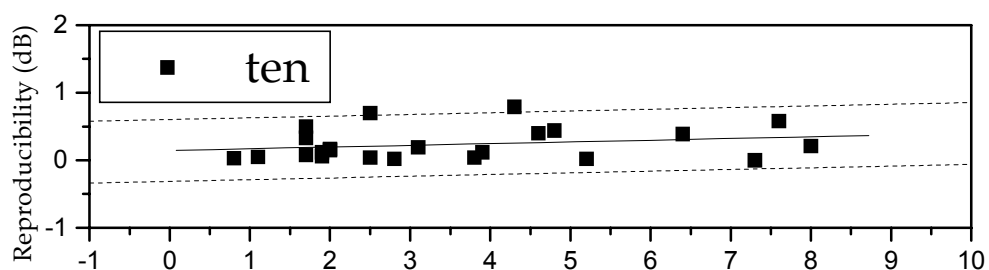


Figure 2a (top), 2b (middle) and 2c (bottom). Variation of reproducibility uncertainty calculated using all noise sources as a function of Directivity index (in dB) on the horizontal scale for microphone array as given in the key box, with best-fit and plus and minus two standard deviation lines.

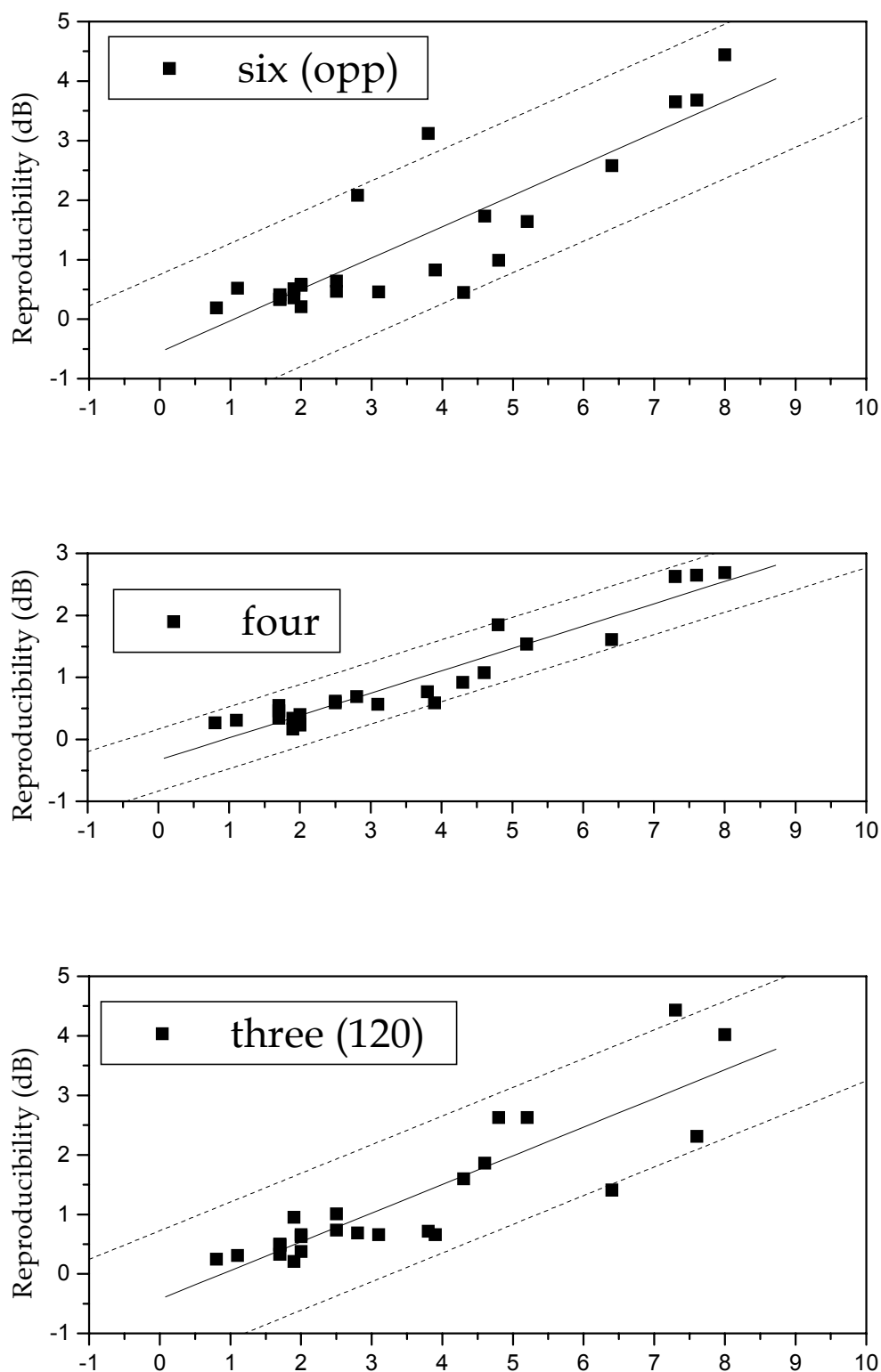


Figure 2d (top), 2e (middle) and 2f (bottom). Variation of reproducibility uncertainty calculated using all noise sources as a function of Directivity index (in dB) on the horizontal scale for microphone array as given in the key box, with best-fit and plus and minus two standard deviation lines.

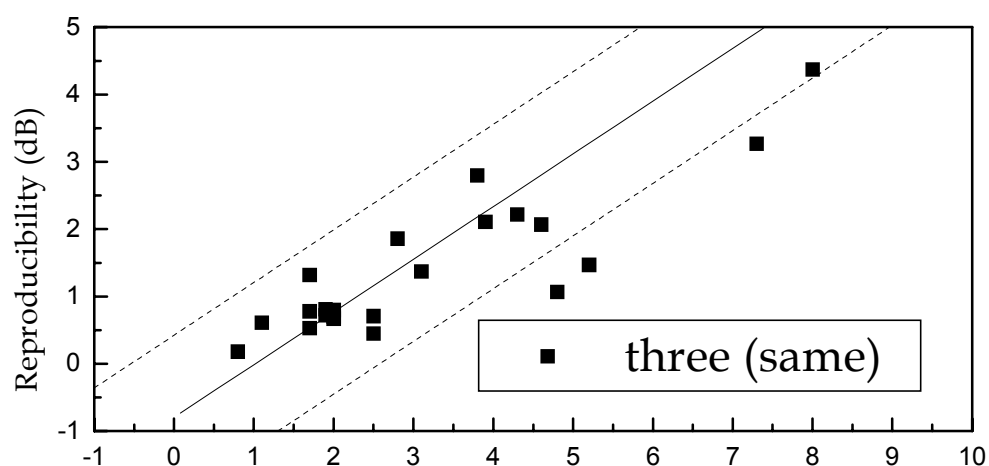
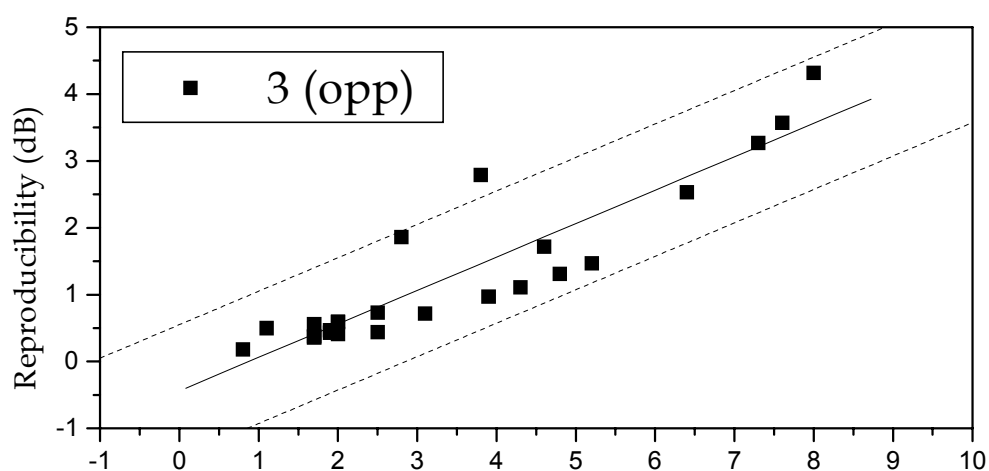


Figure 2g (top), and 2h (bottom). Variation of reproducibility uncertainty calculated using all noise sources as a function of Directivity index (in dB) on the horizontal scale for microphone array as given in the key box, with best-fit and plus and minus two standard deviation lines.

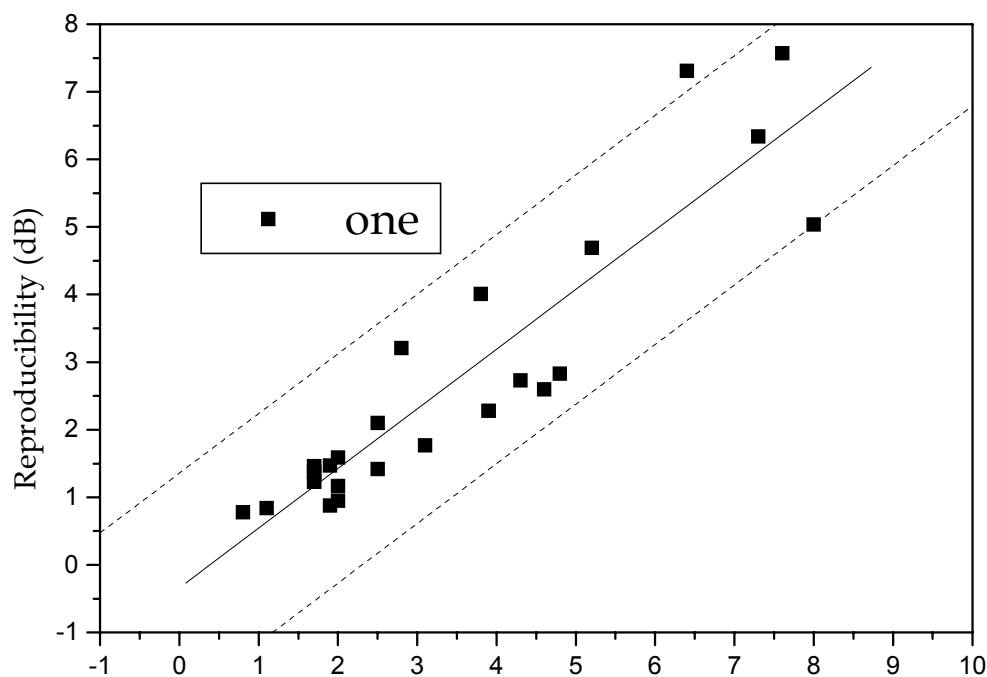


Figure 2i Variation of reproducibility uncertainty calculated using all noise sources as a function of Directivity index (in dB) on the horizontal scale for a single microphone “array” with best-fit and plus and minus two standard deviation lines.

So that data corresponding to each array can be compared more easily, the best fit lines for each array are shown together, on the same axes, in Figure 3. Here it can be seen that, as reported in Reference 8, there is an increase in reproducibility uncertainty as the number of microphones in the array is reduced and as the Directivity Index is increased. As discussed above, the value of reproducibility uncertainty is dependent not only on the number of microphones in the array but also on the distribution of the microphones on the surface of the hypothetical enveloping surface. For a given number of measurement positions, arrays that have, as far as practically possible, microphones positions evenly distributed on the measurements surface should provide the smaller reproducibility uncertainties. The arrays that have microphones evenly distributed over the surface are shown in Figure 3 as bold lines. An examination of the best fit lines associated with the 3- and 6-microphone arrays shows that reproducibility uncertainty values are in fact smallest for the evenly distributed arrays, denoted by “(120)” in Figure 3.

It can also be seen from Figure 3 that the 10-microphone array provides the lowest values of reproducibility uncertainty and furthermore, values are essentially independent of Directivity Index. As the number of microphones in the array is progressively decreased, the value of the reproducibility uncertainty increases in the order of the number of microphones in the array, with the single microphone data resulting in the largest uncertainty.

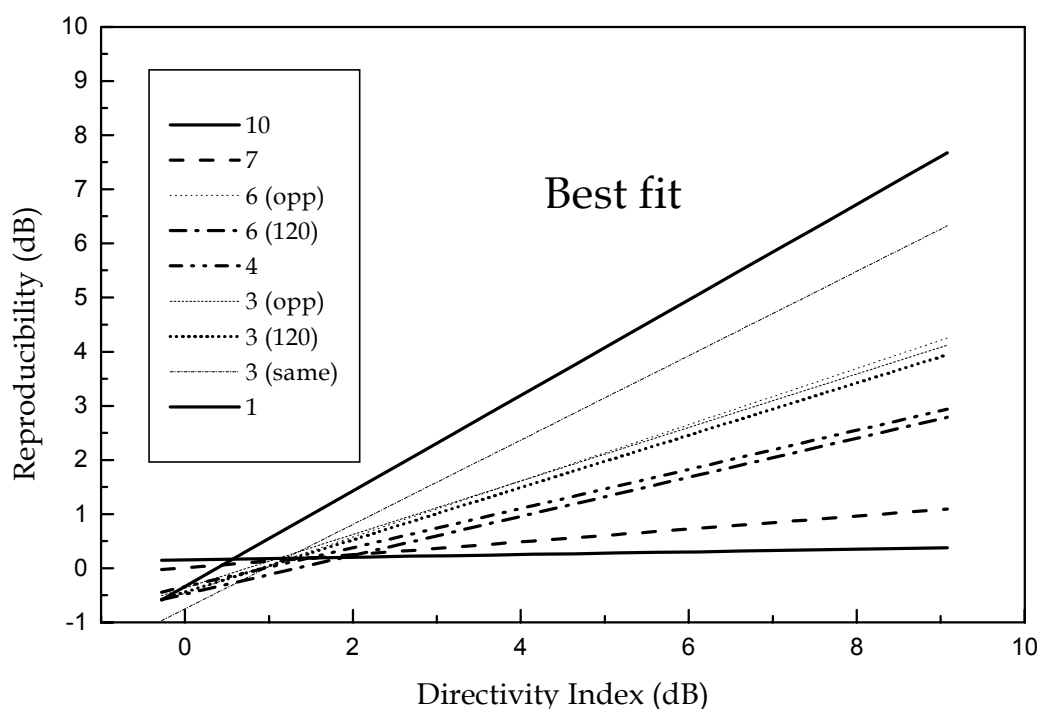


Figure 3 Variation of reproducibility uncertainty, calculated using all noise sources, as a function of Directivity Index for the best fit lines with array configuration as a parameter.

For the purpose of providing reproducibility data suitable for inclusion in an international standard it is the upper limit (plus two standard deviations) that is of interest as statistically it can be expected that data points should lie below this upper limit line. These lines can, therefore, be used with a high level of statistical confidence to assess the reproducibility uncertainty associated with a particular measurement arrangement. This means that the machinery manufacturer can be confident in a labeled value if it is obtained using this upper limit to assess measurement uncertainty.

The plus two standard deviation lines for each of the nine arrays from Figures 2a to 2i are shown in Figure 4 displayed using the same format as used in Figure 3. It can be seen that the conclusions drawn from Figure 3 still apply although the values of reproducibility associated with a given array and Directivity Index are, of course, larger. However, the relationship between reproducibility uncertainty and the number of microphones used in the array is a little confused as the 6-microphone (120) array is now associated with larger values of reproducibility uncertainty than the 4-microphone array. This is a result of the larger data scatter and subsequent higher standard deviation associated with the goodness of fit for the six-microphone sub-set (see Figure 2c). This larger data scatter was in part due to differences between horizontal and vertical directionality sources resulting from the absence of an overhead microphone in the array (ISO 3744 position 10 or 20). So, for sources with a vertical directionality the energy radiated in an upwards direction is not adequately accounted for. This

problem is addressed in more detail below where only data obtained using actual machines is considered.

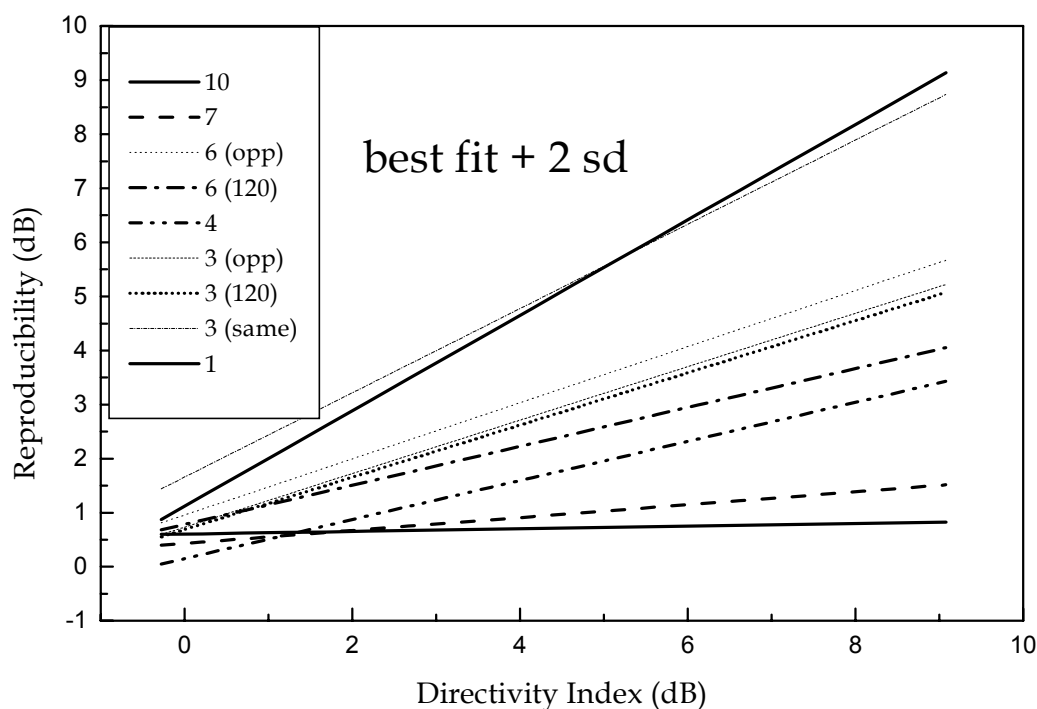


Figure 4 Variation of reproducibility uncertainty, calculated using all noise sources, as a function of Directivity Index for the plus two standard deviation lines with array configuration as a parameter.

As briefly discussed above it is possible that reproducibility values may be adversely affected by the data obtained using the sources specially constructed in order that some data could be obtained for high values of Directivity Index. From Table 11, it can be seen that generally the standard deviations associated with the best-fit lines for arrays with six microphones or less are high compared to values obtained for the ten position arrays of ISO 3744. An examination of Figures 2a to 2i indicates that these relatively high standard deviations result from data obtained using noise sources with high values of Directivity Index. Because there are few actual machines with such high values of Directivity Index, it was necessary to construct special noise sources to obtain data where Directivity Index is greater than approximately 5 dB. These sources used a reference sound source fixed inside a 40 mm square section tube constructed of 20 mm thick MDF material. Several configurations were used with the tube orientated on its side with either both ends open or with one end open or upright with only the top end open. In addition, the length (or height) of the tube varied between 230 mm and 690 mm. So, some of these sources were highly directional in the vertical plane and others in the horizontal plane. To assess the affect of these special sources on the results discussed above the data has been re-analysed using only sound pressure level measurements made on actual machines. The standard deviations of reproducibility for all sub-sets from sub-section 3.3 and the extra 3-, 6- and 7-microphone sub-sets described in this sub-section are shown in the

following nine displays, numbered Figure 5a to 5i, as a function of Directivity Index with one display for each microphone sub-set considered. As for the data in the nine displays of Figure 2, a least squares linear best fit line has been fitted to each data set (the solid line). As an indication as to the goodness of fit the standard deviation (s.d.) of the differences of each data point from this line have been calculated. The best fit lines are of the form $y = mx + C$. The constants “m” and “C” are listed in Table 12 together with the associated standard deviation (s.d.).

Table 12 Constants and standard deviations for best fit lines for machines only

No of microphones	m	C	s.d. (dB)
10	0.10038	0.01717	0.21
7	0.17591	- 0.12229	0.18
6 (120)	0.19597	- 0.01917	0.27
6 (opp)	0.21430	0.03488	0.19
4	0.28204	- 0.14573	0.24
3 (120)	0.45604	- 0.33698	0.36
3 (opp)	0.29902	- 0.05755	0.15
3 (same)	0.39630	0.05113	0.37
1	0.51583	0.29605	0.22

It can be seen from Table 12 that the standard deviations associated with all arrays, especially those using six or less microphones, are much smaller than the corresponding data calculated using results from all the noise sources shown in Table 11. This is reflected in the reduced data scatter shown in the nine displays of Figure 5.

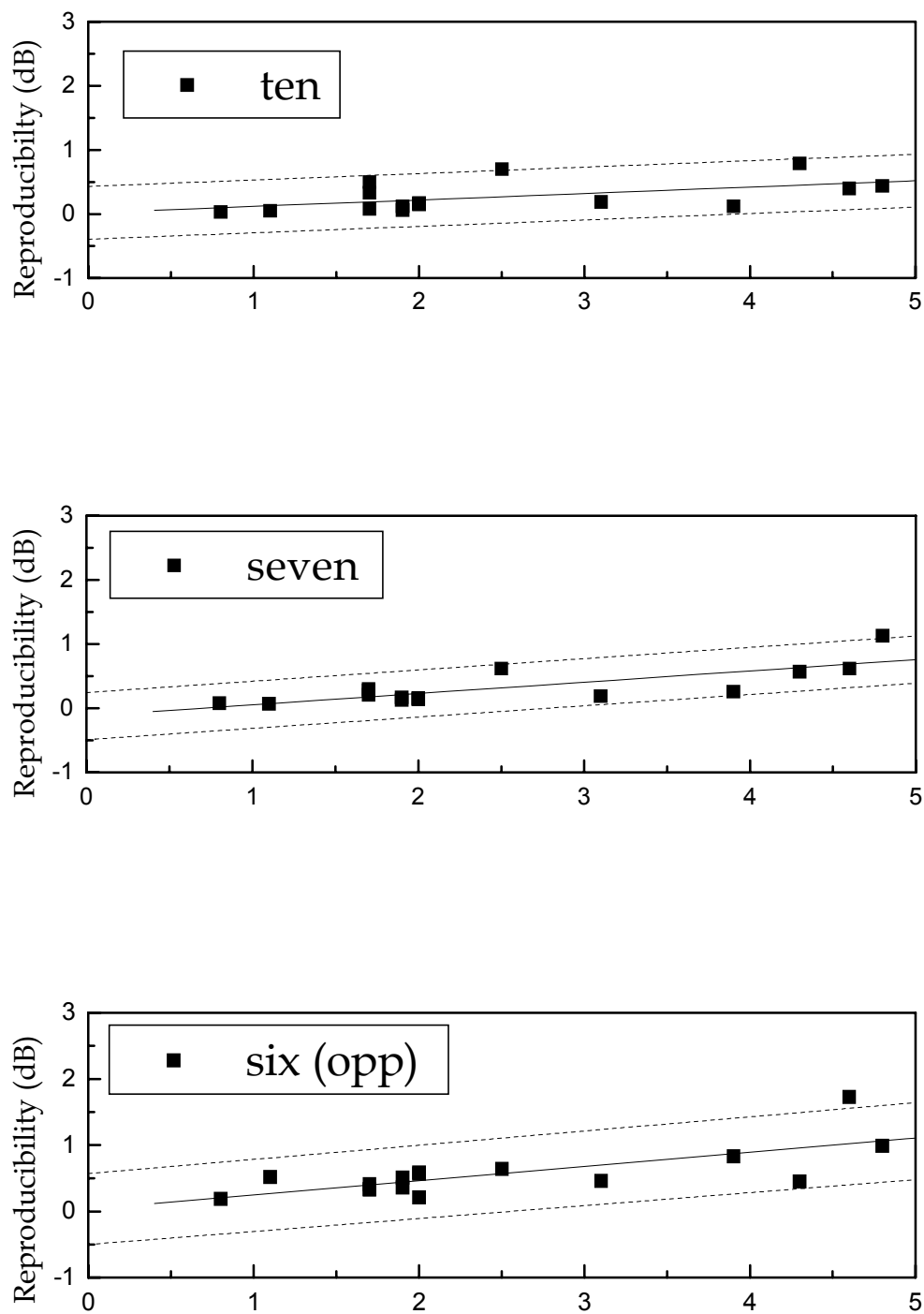


Figure 5a (top), 5b (middle) and 5c (bottom). Variation of reproducibility uncertainty calculated using only machine sources as a function of Directivity index (in 5 dB) on the horizontal scale for microphone array as given in the key box with best-fit and plus and minus two standard deviation lines.

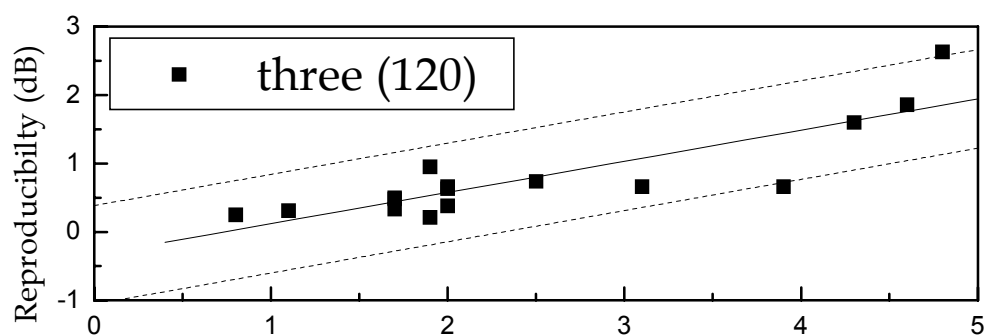
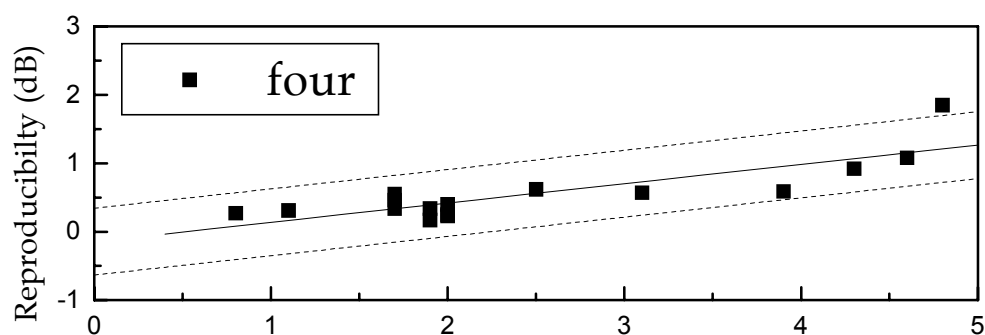
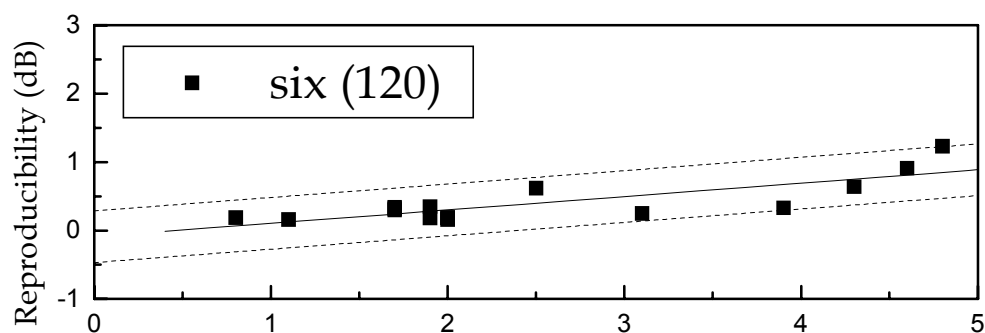


Figure 5d (top), 5e (middle) and 5f (bottom). Variation of reproducibility uncertainty calculated using only machine sources as a function of Directivity index (in 5 dB) on the horizontal scale for microphone array as given in the key box with best-fit and plus and minus two standard deviation lines

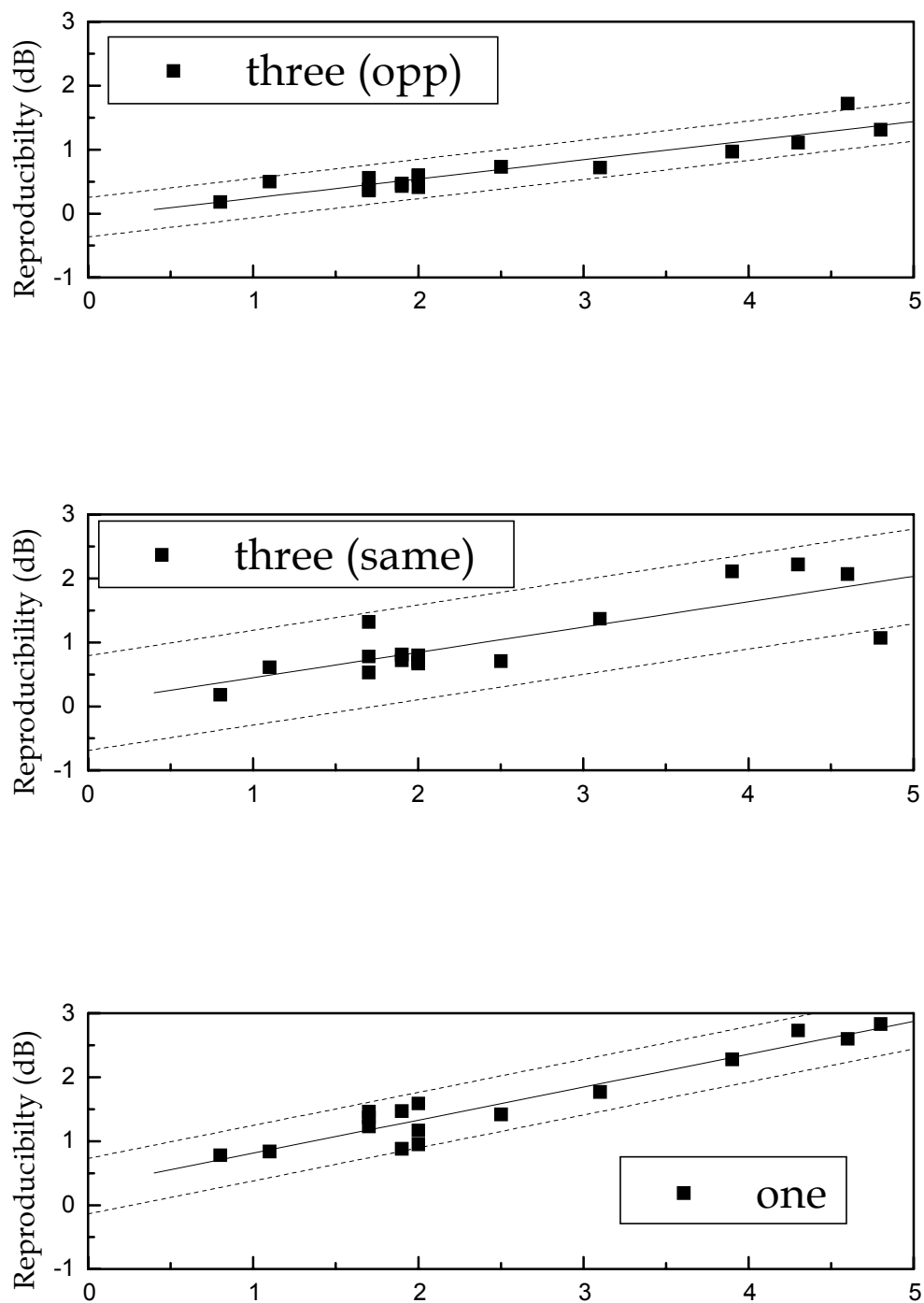


Figure 5g (top), 5h (middle) and 5i (bottom). Variation of reproducibility uncertainty calculated using only machine sources as a function of Directivity index (in dB) on the horizontal scale for microphone array as given in the key box with best-fit and plus and minus two standard deviation lines

As for the all-noise-source results discussed above, all nine best fit lines are displayed in Figure 6 and the nine plus two standard deviation lines are displayed in Figure 7 both with the same format as used in Figure 3 and 4.

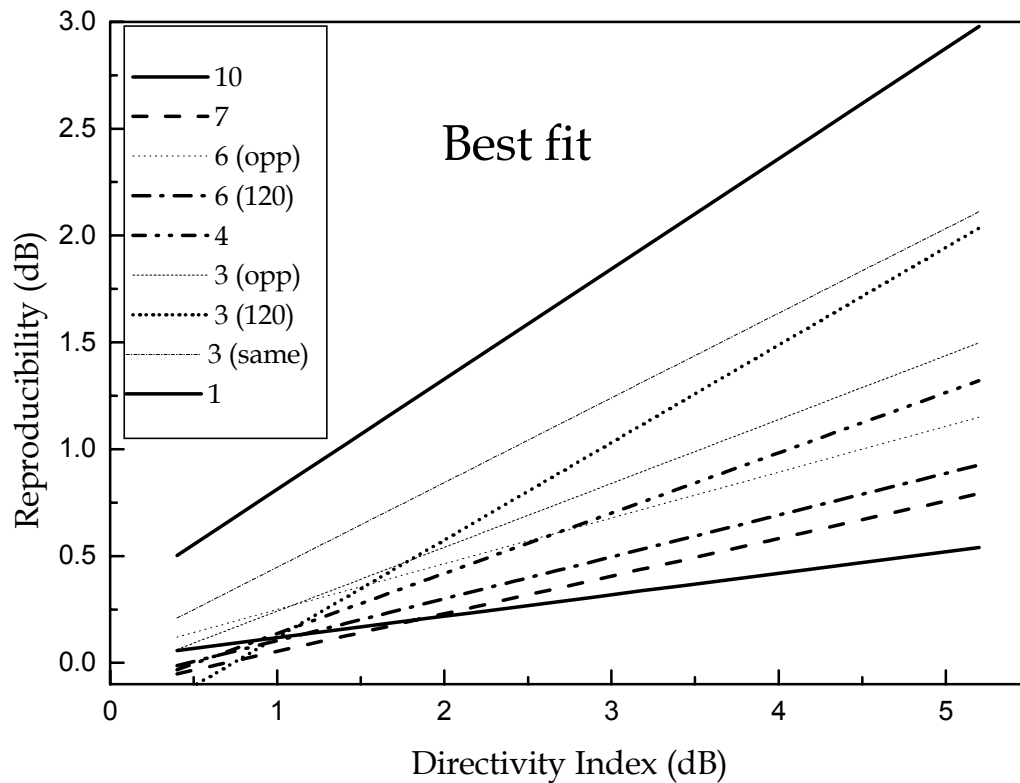


Figure 6 Variation of reproducibility uncertainty, calculated using only machine noise sources, as a function of Directivity Index for the best fit lines with array configuration as a parameter.

From Figure 6 it can be seen that the best fit lines overlap for low values of Directivity Index. While this may be a little confusing, the values of reproducibility associated with all arrays for these low values of Directivity Index are small and so a decision regarding the use of an array with a larger number of microphones to improve the level of uncertainty will not need to be made. The value of reproducibility can be seen to increase as Directivity Index increases. This was observed for the all-noise-source data in Figure 3. However, for these machine-only data the relationship between the number of microphones in the array and the value of reproducibility is much clearer, especially at higher values of Directivity Index.

It can be seen from Figure 6 that the 10-microphone array provides the smallest values of reproducibility, followed by the 7-microphone array, both the 6-microphone arrays, the 4-microphone array, all of the 3-microphone arrays and the largest values of reproducibility are provided by the single microphone. The corresponding all-source data in Figure 3 showed the same trends but the array order was not so clear, for example one of the 6-microphone arrays can be observed to be amongst the set of 3-microphone arrays. The magnitude of reproducibility for a given value of Directivity Index and microphone array, is very similar for both the all-noise-source data and these machine-only results, with perhaps slightly larger values for the former.

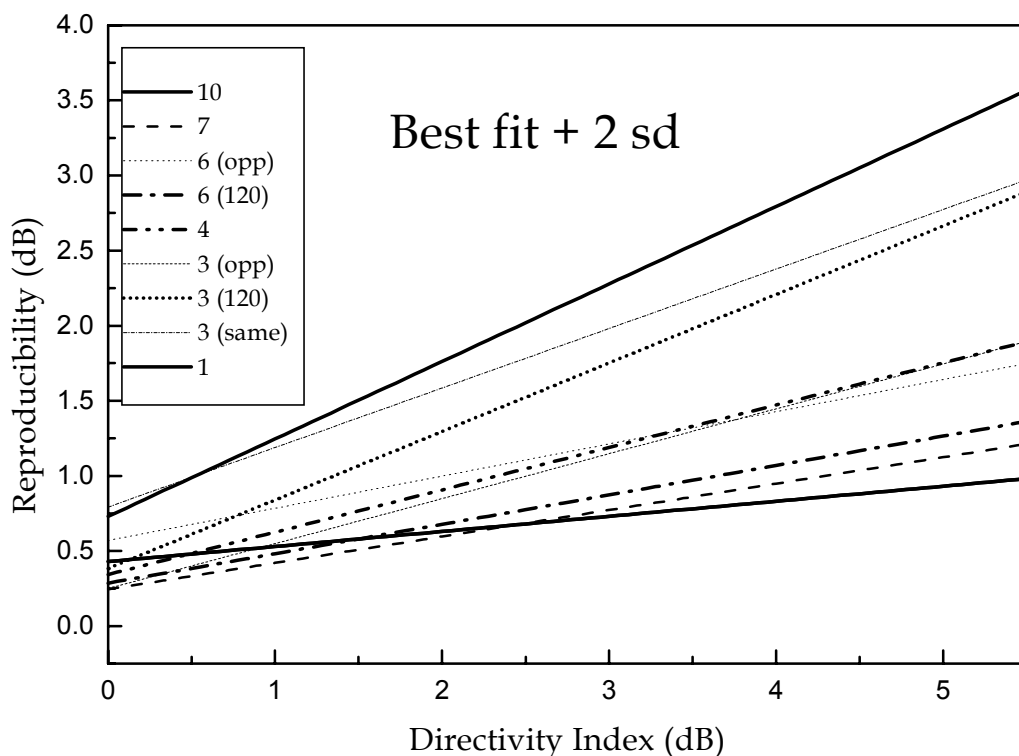


Figure 7 Variation of reproducibility uncertainty, calculated using only machine noise sources, as a function of Directivity Index for the plus two standard deviation lines with array configuration as a parameter.

Figure 7 shows the plus two standard deviation lines which, as discussed above, are more important when considering the requirements of an international standard. As observed in the corresponding all-noise-source data in Figure 4, there is some overlapping at low values of Directivity Index. However, at higher values the relationship between reproducibility and the number of microphones as the Directivity Index is varied becomes much clearer and is similar to the best fit line observations discussed above. The magnitude of reproducibility, for a given value of Directivity Index, obtained from these plus two standard deviation lines is, as would be expected, higher than that obtained from the best fit lines of Figure 6, but the increase is not as large as can be observed from the all-noise-source results in Figures 3 and 4. This is a direct result of the smaller data scatter about the best fit lines shown in the nine displays of Figure 5. This means that the increase in the magnitude (above values obtained from the best-fit lines) of reproducibility of values obtained from these plus two standard deviation lines is reduced.

The observations from the machine-only data discussed above can perhaps be more easily appreciated by taking an example. Consider a highly directional machine with a Directivity Index of 4 dB. Values of reproducibility associated with the best-fit and plus two standard deviation lines for the all-noise-source data and the machine-only data for each of the arrays considered are listed in the first four rows (annotated A to D) of Table 13. The last four rows of Table 13 are differences between sets of data as indicated in the Table.

Table 13 Reproducibility uncertainties (dB) for a Directivity Index of 4 dB

	number of microphones and array description								
	1	3 same	3 opp	3 120	4	6 Opp	6 120	7	10
A. best fit, all sources	3.2	2.4	1.6	1.7	1.1	1.7	1.0	0.5	0.3
B. best fit, machines	2.4	1.7	1.5	1.2	1.0	0.9	0.7	0.6	0.4
C. plus two s.d, all sources	4.7	4.8	2.7	2.8	1.7	3.1	2.3	1.0	0.8
D. plus two s.d, machines	2.8	2.4	2.2	1.6	1.5	1.4	1.1	0.9	1.1
difference (A - B)	0.8	0.7	0.1	0.5	0.1	0.8	0.3	-0.1	-0.1
difference (C - D)	1.9	2.4	0.5	1.2	0.2	1.7	1.2	0.1	-0.3
difference (C - A)	1.5	2.4	1.1	1.1	0.6	1.4	1.3	0.5	0.5
difference (D - B)	0.4	0.7	0.7	0.4	0.5	0.5	0.4	0.3	0.7

It can be seen that values of reproducibility associated with the plus two standard deviation lines for the machine-only data are generally smaller than those associated with the all-noise-source data. It can be seen that the differences in the magnitude of reproducibility between the all-source values and the machine-only values are relatively small when considering the best-fit lines (A - B). However, when considering the plus two standard deviation lines there are some large differences (C - D) with 2.4 dB for one of the 3-microphone arrays and 1.7 dB for one of the 6-microphone arrays. As observed above this is a direct result of the reduced data scatter associated with the machine-only data. This is also reflected in the difference between values of reproducibility obtained from the best-fit lines and those from the plus two standard deviation lines (C - A) and (D - B). Here it can be seen that the differences are much larger for the all-noise-source data (C - A).

It is concluded that for the purposes of inclusion in an international standard that is concerned with the determination of sound power level and which will be used with actual machines as a noise source that reproducibility data should be based on the results shown in Figure 7.

8. REPRODUCIBILITY FOR AN INTERNATIONAL STANDARD

In Sub-section 7.4 the magnitude and form of the variation of the standard deviation of reproducibility with Directivity Index and array configuration was assessed and values suitable for inclusion in an international standard displayed in Figure 7. For inclusion in an international standard these reproducibility data may be more usefully displayed as a function of the number of microphones in an array with Directivity Index as a parameter. This can be shown in either tabular or graphic form. Table 14 contains values of reproducibility that have been extracted from Figure 7 (values for the 6- and 3-microphone arrays are for the bold lines).

Table 14. Values of reproducibility for an international standard in tabular form

number of microphones	Directivity Index (dB)				
	1	2	3	4	5
10	0.52	0.65	0.74	0.81	0.93
7	0.42	0.59	0.77	0.95	1.14
6	0.48	0.68	0.88	1.08	1.25
4	0.64	0.92	1.20	1.47	1.75
3	0.85	1.31	1.75	2.22	2.67
1	1.25	1.75	2.28	2.81	3.31

Although it is usual to provide uncertainty data in tabular form for international standards it is interesting to examine these data in graphical form in Figure 8.

It can be seen from these two displays that for the lower values of Directivity Index there is a slight increase in the value of reproducibility uncertainty when the number of microphones is increased from seven to ten. The values of reproducibility uncertainty associated with machines with low values of Directivity Index can be seen to be relatively small (around 0.5 dB for the 7-microphone array) so this small increase when a 10-microphone array is used is probably of little importance. Even so, at first sight this increase is puzzling. It is suggested that it is an artefact of the curve fitting process exacerbated by a lack of data for sources with a Directivity Index of less than about 1.5 dB. Considering the results discussed in this report it is reasonable to expect the 10-microphone array to be associated with reproducibility uncertainties that are less than those that would be expected for a 7-microphone array and so, it is suggested that for the purposes of an international standard, values of reproducibility uncertainty for the 10-microphone array should be adjusted (see below) to account for this artificial increase in the value of reproducibility.

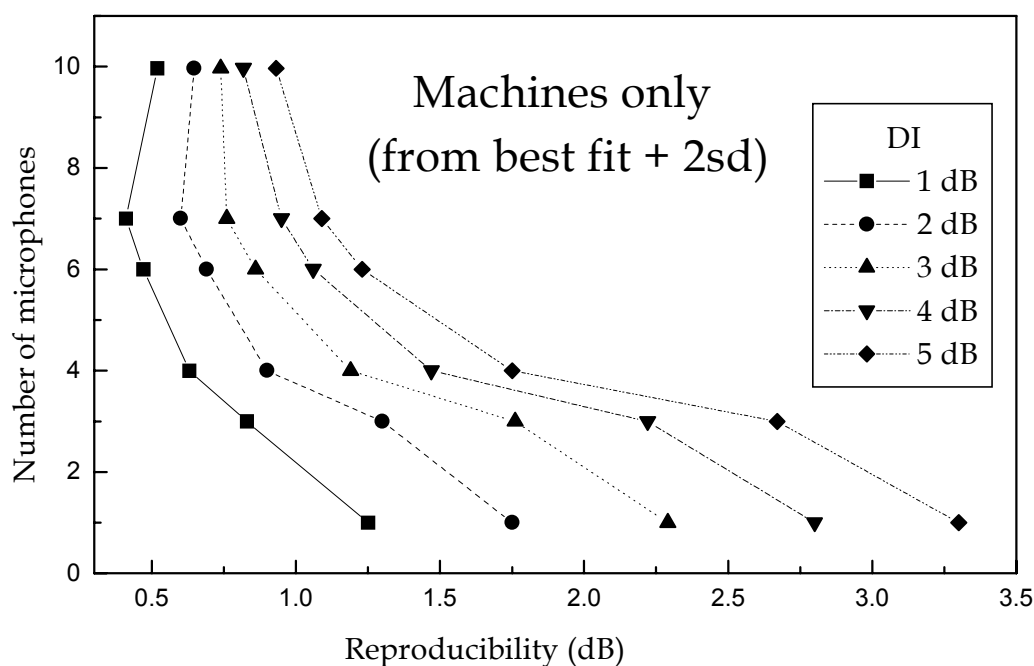


Figure 8 Values of reproducibility uncertainty for an international standard in graphical form

For a given value of Directivity Index, the user of a standard may enter, say Figure 8 with a value of reproducibility that is required and easily assess how many microphones are required in the array. Or it is possible to assess the reduction in reproducibility will be achieved by increasing the number of microphone positions.

It is interesting at this point to consider the values of Directivity Index that are associated with actual machines. The Directivity Index of the machines used in this report are shown in Table 15 together with data for a range of larger machines¹³. The apparent repeat entries for the larger machines cover a range of machine sizes and operations.

It can be seen from Table 15 that there is a range of Directivity Index from 0.8 dB to 8 dB but there is only one machine (the computer cabinet) with a Directivity Index greater than 5 dB, hence the need to use specially constructed noise sources to adequately cover the range. The computer cabinet consisted of a 1.5 m high, 300 mm square metal box with a cooling fan inlet at the bottom of one side and an exit on the top. This “machine” was obviously highly directional on visual inspection. The vacuum cleaner and pump were similarly directional on inspection. The Directivity Index of the majority of machines was less than 4 dB.

It is interesting to examine more closely the distribution of Directivity Index across the machines listed in Table 15. To achieve this, a histogram shown as Figure 9, has been constructed by counting the number of machines with a Directivity Index within 0.5 dB bands from 0.5 dB - 1 dB to 4.5 dB - 5 dB across the range.

Table 15. Directivity Index (dB) for actual machines

machine	Directivity Index	Machine	Directivity Index
RSS	0.8	vacuum cleaner	4.6
mower	1.1	vacuum pump	4.7
generator	1.7	computer cabinet	8.0
shredder	1.7	backhoe loader	1.5
hedge trimmer	1.7	backhoe loader	1.1
compressor	1.9	backhoe loader	2.4
jigsaw	2.0	backhoe loader	2.7
Hair dryer	2.0	wheeled loader	2.3
Food processor	2.0	wheeled loader	2.6
floor buffer	2.5	wheeled loader	1.2
razor	3.1	wheeled loader	2.3
Pc	3.9	crawler excavator	1.6
printer	4.3	crawler excavator	1.7

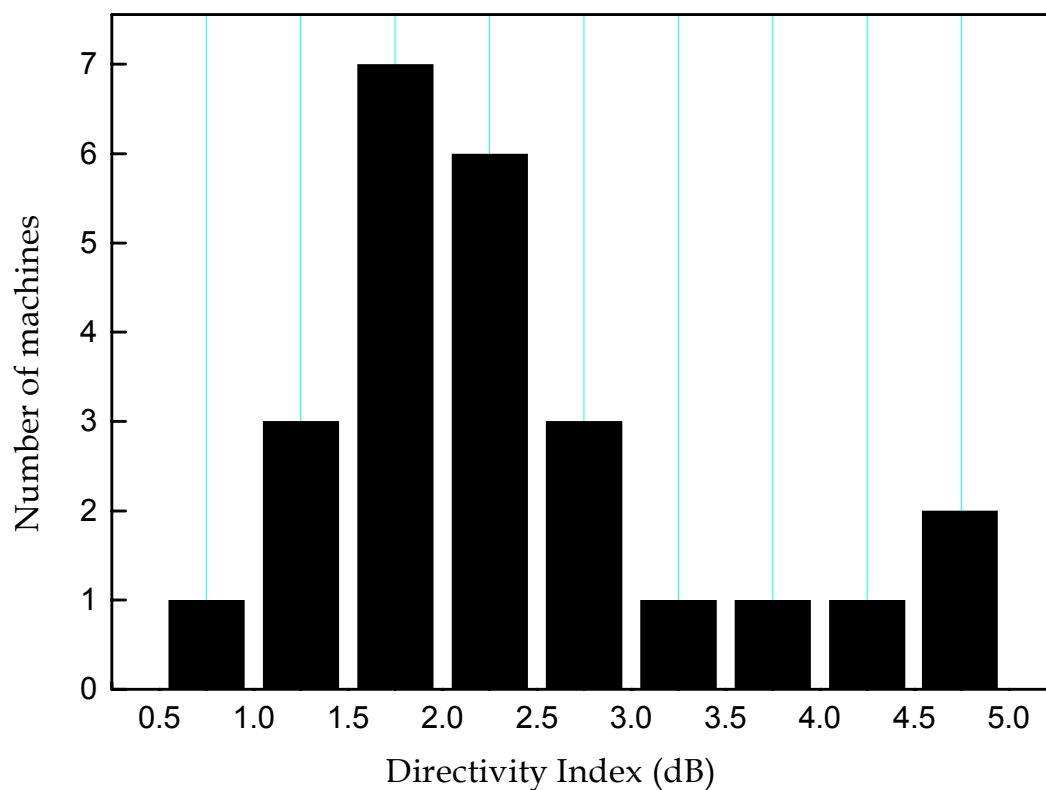


Figure 9 Histogram of machine Directivity Index

From Figure 9 it can be seen that the majority of machines have a Directivity Index between 1 dB and 3 dB, in fact 19 machines out of a total of 25 machines. From these data it seems that if a machine has a particularly low value of Directivity Index (this is probably confined to devices such as a reference sound source) then reproducibility values corresponding to a Directivity Index of 1 dB may be assumed. If on visual inspection the machine is not obviously highly directional (the case for the vast majority of machines) then a medium value of reproducibility corresponding to a Directivity Index of 3 dB may be assumed. If the machine has some obvious directionality components then high reproducibility values corresponding to a Directivity Index of 5 dB may be assumed. For extremely high values of Directivity Index (e.g. the computer cabinet) then it is probably prudent to employ the 10-microphone array which provides sound power level determinations that are essentially independent of Directivity Index and assume reproducibility values for a Directivity Index of 5 dB.

It is proposed therefore, that for use in an international standard the second and fourth columns of Table 14 should be deleted and the reproducibility data presented as in Table 16, together with guidance on selection of Directivity Index as above. In addition, reproducibility uncertainties associated with the 10-microphone array should be adjusted to allow for the apparent increase in value over the 7-microphone data. One way to achieve this would be to assume the value of reproducibility is constant once the number of microphones in the array is increased above seven. Another, and perhaps more reasonable approach is to fit smoothed curves to the data in Table 14 excluding the 10-microphone array and extrapolate to obtain values of reproducibility for the 10-microphone array. This results in reproducibility uncertainties of 0.36 dB, 0.50 dB, 0.65 dB, 0.80 dB and 0.95 dB for a Directivity Index of 1 dB, 2 dB, 3 dB 4 dB and 5 dB respectively. Values rounded to 0.1 dB for use in the standard are shown in bold, those in parenthesis are the actual values.

Table 16. Proposed values of reproducibility for an international standard

Number of microphones	Directivity Index (dB)		
	1	3	5
10	0.4 (0.36)	0.7 (0.65)	1.0 (0.95)
7	0.4 (0.42)	0.8 (0.77)	1.1 (1.14)
6	0.5 (0.48)	0.9 (0.88)	1.3 (1.25)
4	0.6 (0.64)	1.2 (1.20)	1.8 (1.75)
3	0.9 (0.85)	1.8 (1.75)	2.7 (2.67)
1	1.3 (1.25)	2.3 (2.28)	3.3 (3.31)

As discussed in Section 7, reproducibility uncertainty is dependent not only on the number of microphones used in a measurement array but also on their distribution on the measurement surface. It is suggested, therefore, that the microphone positions associated with the arrays in Table 16 should be specified in a standard. It is proposed that the microphone positions from ISO 3744, listed in Table 3, should be used for this purpose and Table 17 should be used in conjunction with Table 16. It should be noted that the single microphone has not been

included as the locations for each of the twenty possible “arrays” are obvious and it is unlikely that this option will be used in practice.

Table 17. Microphone distribution on the hemispherical measurement surface

No of mics	ISO 3744 microphone position number																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
10	•	•	•	•	•	•	•	•	•	•										
10											•	•	•	•	•	•	•	•	•	•
7	•			•			•				•			•			•			•
7		•			•			•				•			•			•		•
7			•			•			•				•			•			•	•
6	•			•			•				•			•			•			
6		•			•			•				•			•			•		
6			•			•			•				•			•			•	
4	•								•						•					•
4						•						•					•			•
4			•					•						•						•
4					•						•								•	•
4		•					•									•				•
4				•									•					•		•
3	•						•							•						
3						•						•					•			
3			•					•						•						
3					•						•								•	
3		•					•									•				
3				•									•					•		

9. IMPLICATIONS FOR ISO 4871

As outlined in Section 1, manufacturers of some machines are required by the EC Directive relating to the noise from machines used outdoors to label their products with a guaranteed A-weighted sound power level. According to the Directive, this guaranteed level is a measured level plus an allowance for uncertainties due to measurement procedures and production variation.

The measurement procedure uncertainty required by the Directive is the repeatability uncertainty. Here sound power level determinations are obtained using the same method on a single machine at the same measurement site by the same operator using the same equipment within a short interval of time.

The quantity that needs to be obtained is the standard deviation of repeatability uncertainty, this is referred to as σ_r . The true value of σ_r can only be found from a very large (infinite) set of sound power level determinations. However, statistics enable an estimate, S_r of the standard deviation to be calculated from a smaller number, n of sound power level determinations.

For the production variation the process is exactly the same as that outlined above for the calculation of the standard deviation of repeatability uncertainty but in this case a single sound power level determination is carried out on a number of machines taken from the production line. Again the quantity to be determined is the standard deviation, but this time it is the standard deviation of production uncertainty σ_p . Again a true value of σ_p , can only be obtained from measurements on a very large number of sound power level determinations. However, an estimate, S_p of the standard deviation of production uncertainty can be obtained from smaller number of machines.

The total estimate of the uncertainty, S_T associated with a sound power level determination is obtained by adding the standard deviation for repeatability and production in quadrature. The total uncertainty is then combined with an appropriate statistical confidence level to obtain a value for the correction to be added to the as measured A-weighted sound power level to obtain the guaranteed value.

If data are not available to enable the manufacturer to estimate values of standard deviation for production variation and measurement process then the guidance given in ISO 4871 may be followed. In this standard the guaranteed sound power level is referred to as the declared sound power level and the correction to be added to the measured sound power level is termed K.

For a single machine a value for K is obtained from:

$$K = 1.645 \cdot \sigma_R$$

where, 1.645 is a statistical coverage factor for a particular confidence level
 σ_R is the standard deviation of reproducibility

The value of σ_R given in ISO 4871 for an engineering grade accuracy is 1.5 dB so, the value of K is 2.47 dB.

When considering a batch of machines the standard gives an example using three machines and here a value for K is obtained from:

$$K = 1.5 \cdot \sigma_M$$

where, 1.5 is a constant derived from sampling theory considerations

σ_M is the reference standard deviation which is a total standard deviation specified for the family of machinery and equipment which is considered typical for batches of equipment from this family (this may be equal to σ_T)

The value of σ_M given in ISO 4871 for an engineering grade accuracy is 2.5 dB so, the value of K is 3.75 dB.

It has been suggested in this report that values of reproducibility uncertainty obtained using the engineering grade procedures detailed in ISO 3744 are less than the 1.5 dB used in ISO 4871. In fact an examination of Table 16 suggests values of between 0.4 dB and 1 dB depending on the value of Directivity Index. For a machine with a Directivity Index of 3 dB (this is typical for the majority of machines) the suggested standard deviation of reproducibility uncertainty is 0.7 dB. Using this reproducibility uncertainty will reduce the value of the correction K for a single machine by 1.32 dB to 1.15 dB.

It is difficult to assess the reduction for the case of batches of machines because this requires a knowledge of σ_p which is used in the formulation of σ_M . However, assuming a value for σ_p of 1 dB (from experience this is perhaps a little on the high side, but not an unreasonable estimate) this would give a value of σ_T (which may be assumed to be equal to σ_M) of 1.22 dB. Using this value reduces the value of K for a batch of machines by 1.92 dB to 1.83 dB.

If it can not be shown that σ_M is equal to σ_T then ISO 4871 assumes σ_M is 0.5 dB larger than σ_T . Using this assumption a value of K of 2.58 dB is obtained, 1.17 dB less than the ISO 4871 value.

So, the value of the correction to allow for uncertainties in sound power determination (and hence the guaranteed level) will be approximately 1 dB lower if the reproducibility uncertainties recommended in this report are used.

10. ONE-THIRD-OCTAVE-BAND SOUND POWER LEVELS

The measurement programme was carried out as summarised at the beginning of Section 3. The A-weighted sound power level results were discussed in Sections 7 and 8. In this Section, the one-third-octave-band sound power levels in the range 50 Hz to 10 kHz are examined. In Sections 7 and 8, where only A-weighted data was considered, measurement uncertainties were assessed in terms of repeatability, intra-site repeatability and reproducibility. The contribution of these uncertainty data to an overall assessment of measurement uncertainty was examined and data compared to results obtained in an earlier study. Because of the vast amount of data involved when considering 24 one-third-octave-band sound power levels only reproducibility uncertainties will be considered in this Report. It is these values that are necessary for international standards and a comparison with earlier data is not required (Reference 8 only considered A-weighted sound power levels).

10.1 SOUND POWER LEVEL SPECTRA

The one-third-octave-band sound power levels determined by each laboratory are displayed in Figures 10, 11, and 12 for the reference sound source, generator and the box source respectively.

It can be seen that the three sources have significantly different sound power spectra. The frequency spectrum for the reference sound source is, as would be expected, the smoothest, with the range between maximum and minimum one-third-octave sound power levels of approximately 10 dB. The range of one-third-octave sound power levels for the other two sources is much larger being approximately 20 dB for the box source and nearly 25 dB for the generator. The variations between adjacent one-third-octave-bands are reasonably smooth for the reference sound source and the box source with a distinct low frequency tone present for the latter. The spectrum for the generator, on the other hand, can be seen to be very jagged with variations between adjacent one-third-octave-bands of around 10 dB. It is clear from an examination of the three Figures that the three noise sources encompass a reasonable range of acoustic complexity.

The data shown in figures 10, 11 and 12 are the average of the three repeat sound power levels, expressed in dB, determined by each Laboratory using the 20-microphone array. All the sound pressure levels measured at each of the twenty microphone positions described in Table 1 are listed in Appendix 1.

It can be seen that for all noise sources there is a data scatter in all bands, with a range generally less than approximately 2 dB. The low-frequency data for the box source in Figure 11 show a large variation mainly due to the effects of background noise. Whatever the reason, these low frequency results are used with care in the statistical analyses in this Report. These variations in sound power level are shown as reproducibility standard deviations in Figures 13, 14 and 15 in sub-section 10.2.

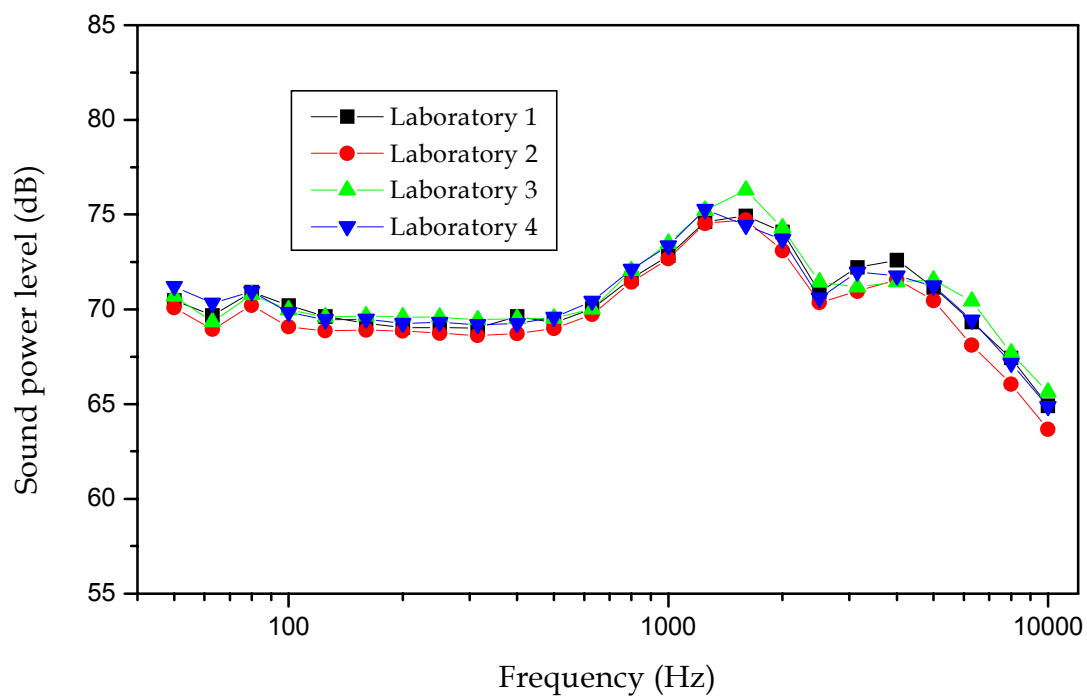


Figure 10. One-third octave-band sound power spectra for the reference sound source

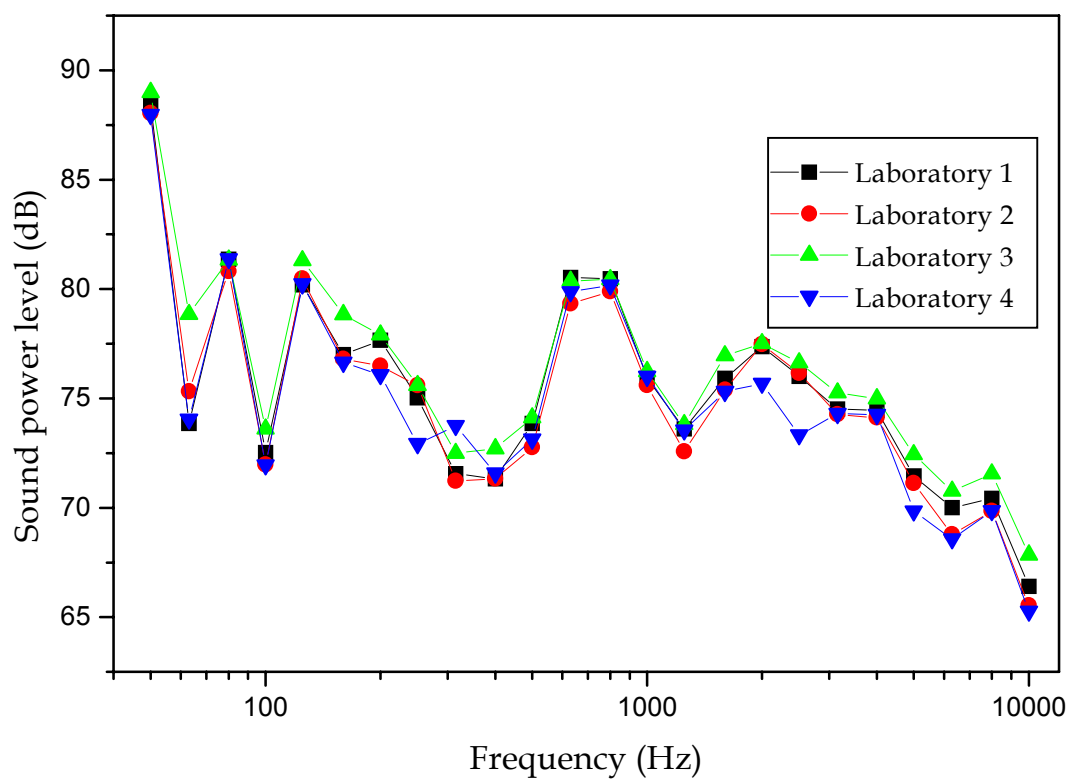


Figure 11. One-third octave-band sound power spectra for the generator

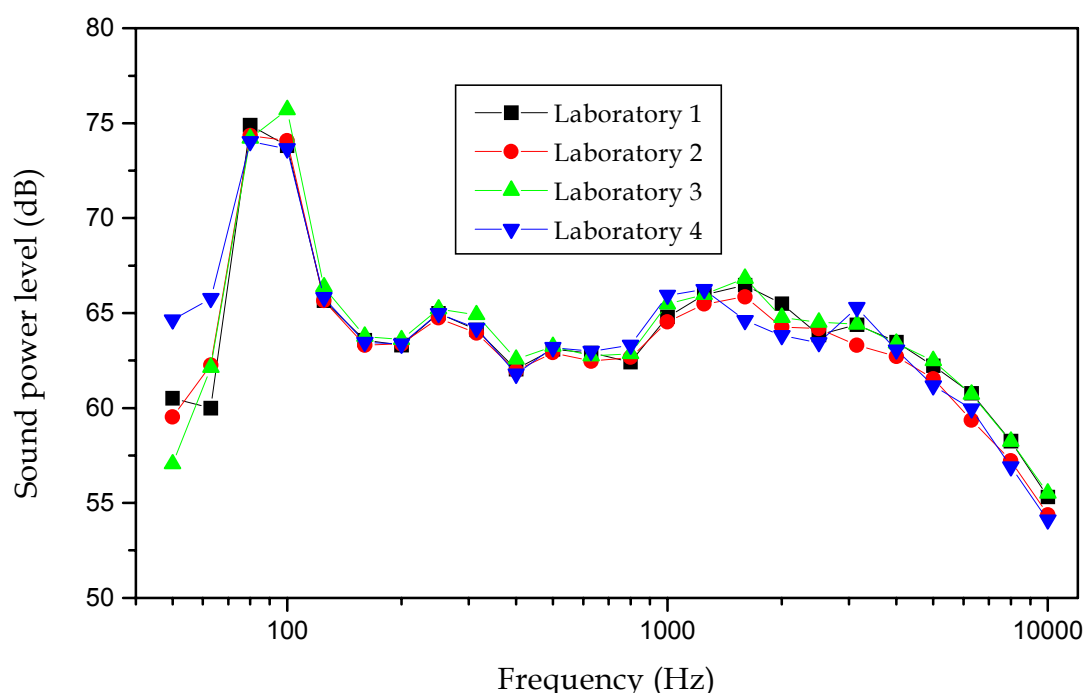


Figure 12. One-third octave-band sound power spectra for the box source

10.2 ONE-THIRD OCTAVE-BAND REPRODUCIBILITY UNCERTAINTIES

As for the A-weighted data discussed in Section 7, standard deviations of reproducibility uncertainties have been calculated as described in Section 4 for each of the nine spatial sampling microphone array sub-sets listed in sub-section 3.3 and sub-section 7.4. In Section 7 it was found that for the majority of microphone sub-sets a correction for K_{2A} did not produce a significant reduction in the calculated value of the reproducibility uncertainty and so for the one-third-octave-band data only as measured values have been considered and standard deviations have been calculated relative to the 20-microphone array sound power determination.

Values of the standard deviation of reproducibility for one-third-octave-bands from 50 Hz to 10 kHz are shown, for the nine microphone arrays in Figures 13, 14 and 15 for the reference sound source, the generator and the box source respectively.

It can be seen from all three Figures that the reproducibility uncertainties associated with a single microphone sound power determination are very large and vary considerably with one-third octave-band frequency, especially for the box source that has a high Directivity Index. It is unlikely that a one-third octave-band sound power determination obtained using a single microphone position will ever be an acceptable option in international standards and so it will not be considered further in this report.

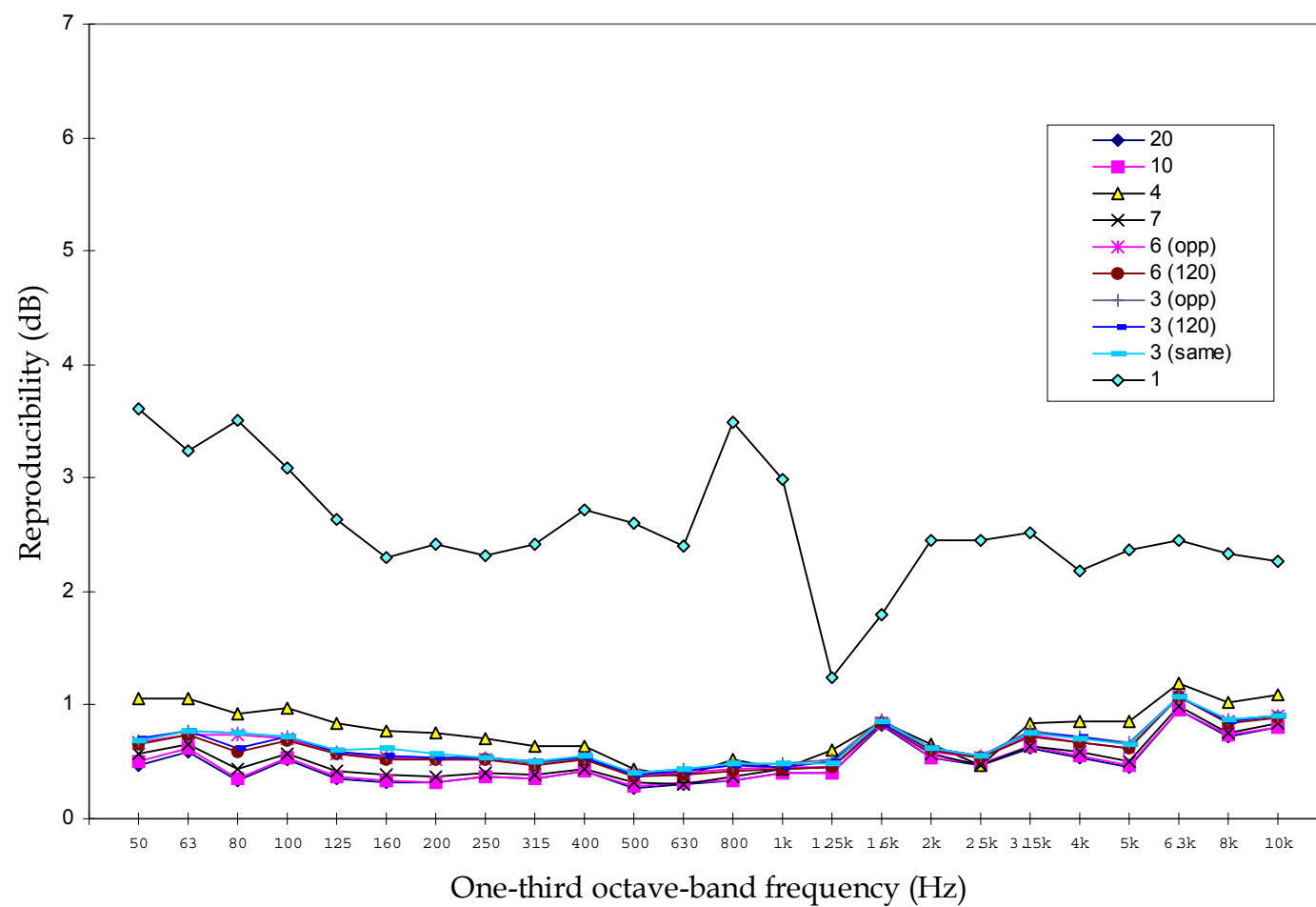


Figure 13 One-third octave-band reproducibility uncertainties for the reference sound source

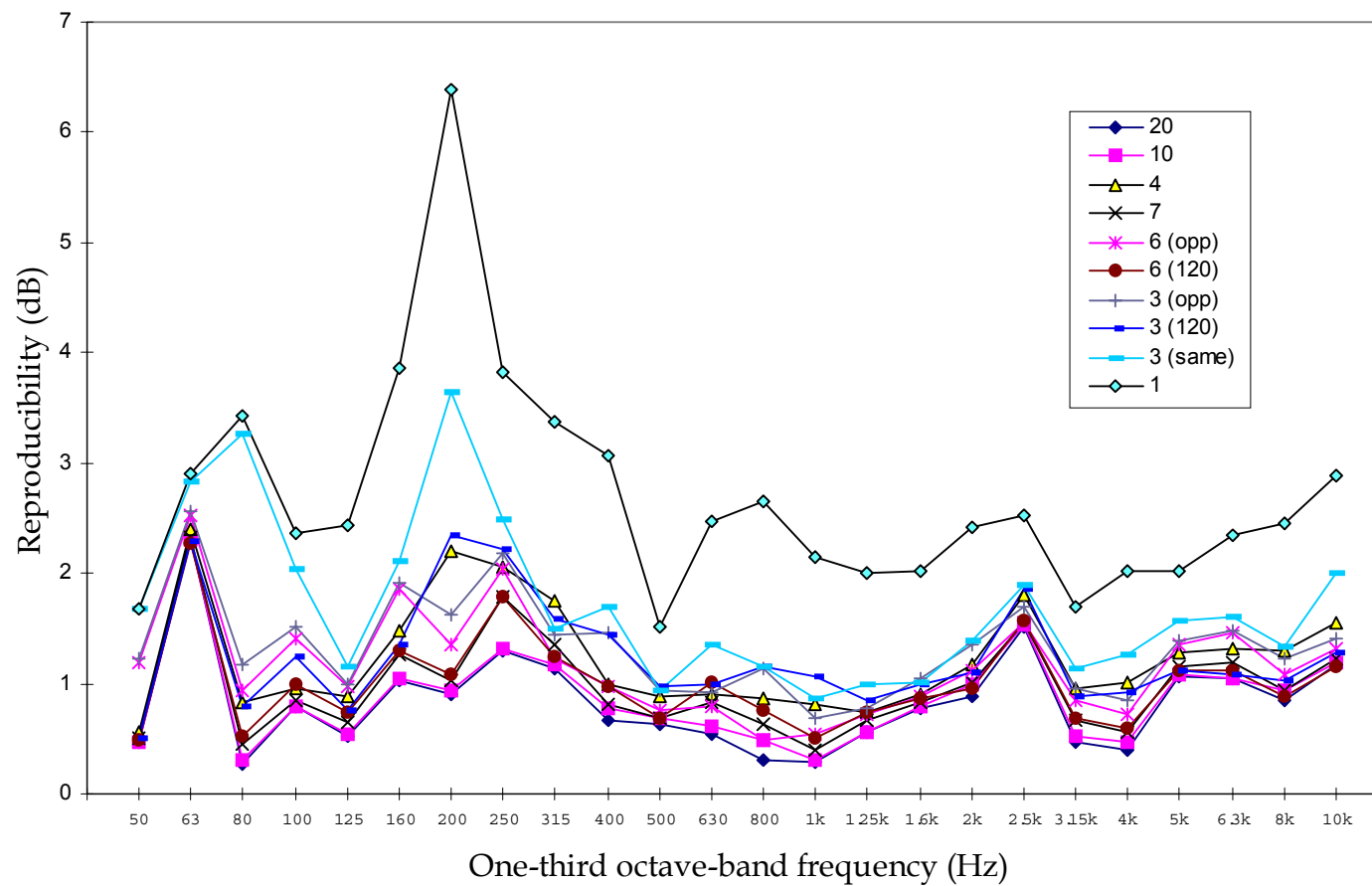


Figure 14 One-third octave-band reproducibility uncertainties for the generator

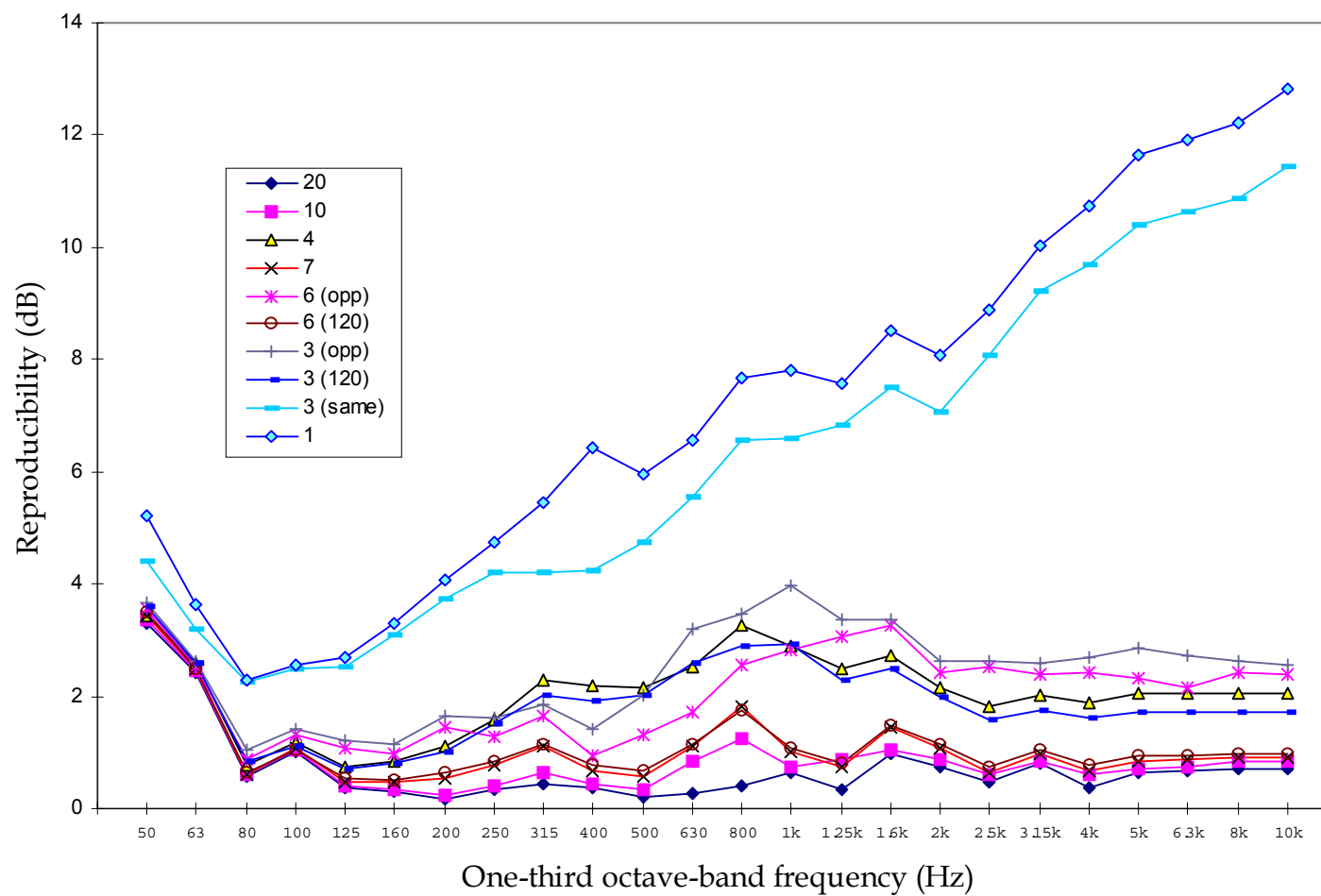


Figure 15 One-third octave-band reproducibility uncertainties for the box source

It can be seen from Figure 13 that, for the reference sound source, reproducibility standard deviations are generally less than 1 dB for all frequency bands and microphone arrays. As for the A-weighted data, there is not a marked variation of reproducibility uncertainty with the number of microphones used in the array (the data scatter is generally less than 0.5 dB and for the middle frequency range around 0.25 dB) with values for 10- and 20-microphone arrays generally the lowest. In the current 3740 series of sound power standards, values of reproducibility uncertainty are quoted for particular frequency ranges. From an examination of Figures 13, 14 and 15 it is convenient to use three frequency ranges, say low (50 Hz to 250 Hz), middle (315 Hz to 2500 Hz) and high (3150 Hz to 10000 Hz). From Figure 13 it can be seen that reproducibility uncertainties of 1 dB, 0.75 dB and 1 dB are associated with the low middle and high frequency ranges respectively. These values may be compared to the A-weighted standard deviations of about 0.35 dB for all arrays except the single microphone determination that reached 0.65 dB.

The results for the generator can be seen from Figure 14 to be a little more variable from band to band but standard deviations are generally less than about 2 dB. Here there is a little more variation between data from the different arrays with a range of between 0.5 dB and 1 dB, but with the 10- and 20-microphone data still associated with the smallest standard deviations. In fact, apart from the 63 Hz band and the 200 Hz band the standard deviations of reproducibility associated with most of the arrays are approximately 1 dB. Because of background noise levels there is some doubt about the low frequency data so the 63 Hz results may be invalid. As was found for the A-weighted sound power level data (see Section 7) the value of reproducibility uncertainty increases as the Directivity Index of the noise source increases. This can also be seen from Figure 16 where each of the 24-one-third octave-band reproducibility values are shown as a function of the corresponding one-third octave-band Directivity Index together with linear best-fit lines. For clarity, only data from the 4-microphone array and the single microphone for the generator are shown. The dependence of reproducibility uncertainty on Directivity Index can be clearly observed from an examination of the inclination of the best-fit lines. In fact, the slopes of the two best-fit lines are very similar to those for the corresponding A-weighted data shown in Figure 3.

So, the increase in the standard deviations around 200 Hz is probably associated with an increase in Directivity Index. This can be seen clearly from an examination of Figure 17 where the Directivity Index data of Table 4 are shown in graphical form. It can be seen that the average Directivity Index for the generator for the lower frequency region is about 3.5 dB and around 200 Hz the value approaches 7 dB.

It can also be seen from Figure 17 that there is an increase in Directivity Index for the frequency range around 2 kHz above the average for this higher frequency region. Although much less marked it may account for the larger values of reproducibility uncertainty at 2.5 kHz.

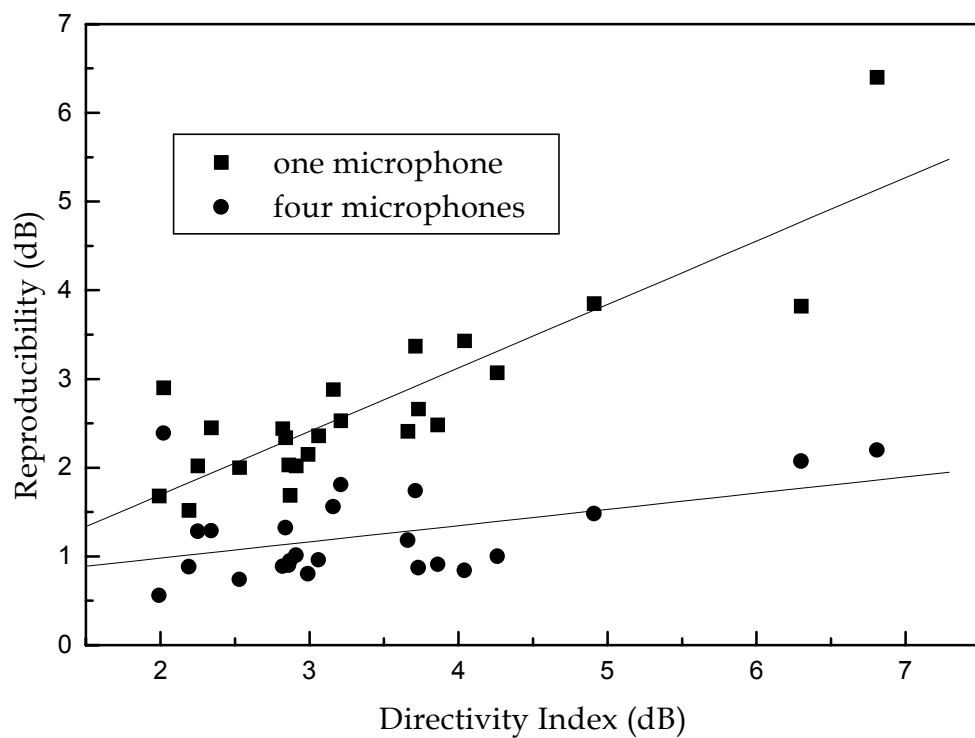


Figure 16 One-third octave-band reproducibility as a function of Directivity Index

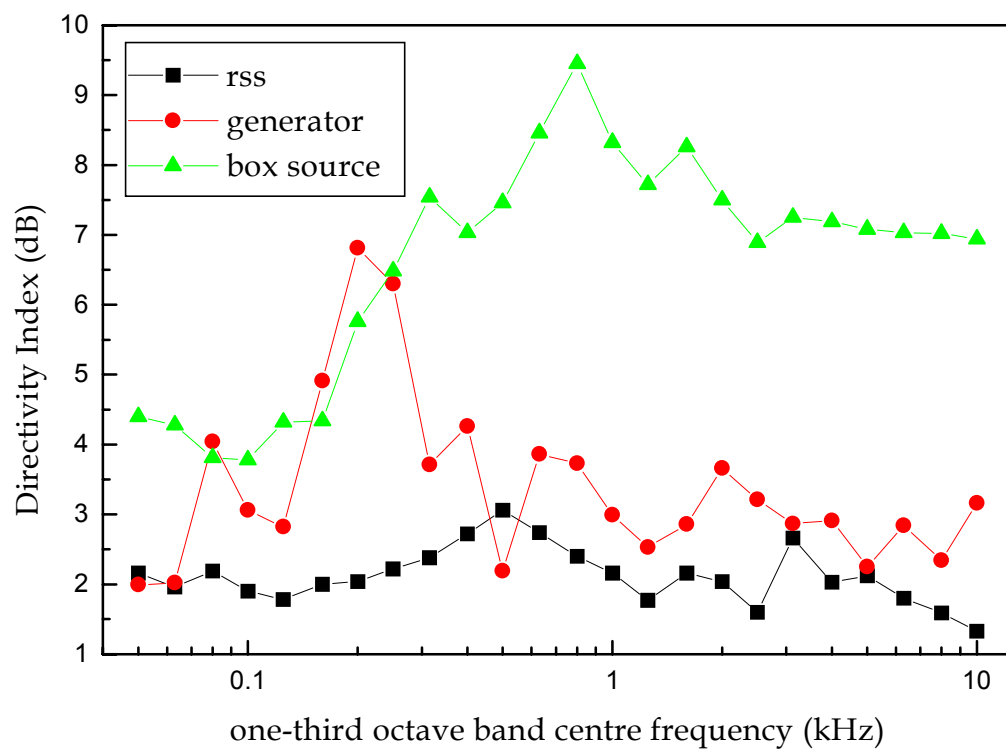


Figure 17 Directivity Index as a function of one-third octave-band frequency

If the three frequency ranges considered for the reference sound source are assumed here then standard deviations of approximately 2 dB, 1 dB and 1.5 dB may be quoted for the low, middle and high frequency ranges respectively. These values may be compared to the A-weighted standard deviations of about 0.5 dB for all arrays except the single microphone determination that reached about 1.1 dB.

The standard deviations for the box source are shown in Figure 15. It can be seen that, with the exception of the single microphone and the 3(same) array data, the standard deviations are generally less than about 3 dB, with a slight increase above this value in the 1 kHz region. It can also be seen from Figure 15 that there is a more marked variation between reproducibility values associated with the different arrays with similar results from the 10- and 20-microphone data which are still associated with the smallest standard deviations (less than 1 dB across the frequency range). The 50 Hz and 63 Hz data are affected by background noise and so have been neglected in this analysis.

The increase in the standard deviations for frequencies in the region of 1 kHz is probably associated with an increase in Directivity Index in this frequency range. It can be seen from the box source data in Figure 17 that the Directivity Index in this range approached 10 dB from a lower frequency value of about 4 dB and a higher frequency value of around 7 dB.

For this highly directional noise source values of standard deviation of reproducibility for the three frequency ranges assumed for the reference sound source and the generator are dependent on the microphone array that is used. For instance for the higher frequency range standard deviations are less than 1 dB for the 20-, 10-, 7- and 6-microphone arrays, and 2 dB for the 4- and 3-microphone arrays. For the middle frequency range corresponding values are 1.5 dB and 3 dB and for the lower frequency range 0.75 dB and 1.5 dB. These values may be compared to the A-weighted standard deviations of 0.26 dB and 0.42 dB for the 20- and 10-microphone arrays, 1.69 dB and 1.91 dB for the 3- and 4-microphone arrays and 2.64 dB and 2.42 dB for the 3 (opp)- and 6-microphone arrays. The A-weighted standard deviation for the single microphone determination was 7.49 dB and from Figure 4 it can be seen that the corresponding higher frequency value varied from around 7.5 dB to 9.5 dB.

When considering reproducibility uncertainty values for inclusion in an international standard it would seem prudent, at first sight, to use the higher values of those above i.e., low frequency 1.5 dB, middle frequency 3 dB and high frequency 2 dB.

For the purposes of labelling machines with a guaranteed A-weighted sound power level in order to conform with the requirements of the numerous EC Directives, it is likely that manufacturers may accept high values of measurement uncertainty in order to reduce the noise measurement effort (as discussed in section 7). However, if one-third octave-band sound power levels are required by the manufacturer it is likely that the data is to be used for research or product development purposes and so a less precise sound power determination will probably not be acceptable. For the purposes of an international standard it is suggested that a 10-microphone array should be specified when considering one-third octave-band sound power levels with appropriate values of reproducibility uncertainty.

Considering the data discussed above, a value of reproducibility standard deviation of 1 dB across the frequency range from 50 Hz to 10 kHz would seem to satisfy all but a few of the data points shown in Figures 13 to 15. However, it is probably wise to err on the safe side, so

it is suggested that a reproducibility uncertainty value of 1.5 dB should be adopted. This compares with values currently specified in ISO 3744 of 3 dB for the 100 Hz, 125 Hz and 160 Hz, 2 dB for 200 Hz to 630 Hz bands, 1.5 dB for the 800 Hz to 5 kHz bands and 2.5 dB for 6.3 kHz, 8 kHz and 10 kHz bands.

11. CONCLUSIONS

A programme of inter-laboratory measurements designed to obtain estimates of the standard deviation of reproducibility associated with sound power level determinations has been carried out. These values of reproducibility uncertainty have been compared with the values obtained by Payne and Simmons (Reference 8) based on repeatability data, and uncertainty values suitable for inclusion in international standards have been proposed.

Four Laboratories carried out sound power level determinations using a hemispherical enveloping surface on three noise sources encompassing a wide range of acoustic complexity and covering a Directivity Index range from 0.8 dB to 6.9 dB.

11.1 A-WEIGHTED RESULTS

11.1.1 Repeatability uncertainty

The standard deviation of repeatability uncertainties are generally less than 0.2 dB and for the reference 20-microphone array are of the order 0.05 dB.

11.1.2 Intra-site repeatability uncertainty

The standard deviations of intra-site repeatability show a marked increase as the number of measurement positions is reduced to one. The magnitude of this increase in value is dependent on the noise source, being smallest for those with a low Directivity Index and largest for those with a high Directivity Index.

For the 20-microphone array, the standard deviations of intra-site repeatability ranged from 0.29 dB for low values of Directivity Index to 0.42 dB for higher values of Directivity Index. Values for other arrays were larger and were in excess of 7 dB for a single microphone with the highly directional noise source.

Although the four measurement sites used were all in the category described in ISO 3744 that may be considered as having values of K_{2A} that may be neglected, an adjustment for the actual values of K_{2A} reduced intra-site repeatability values for the 20- and 10-microphone arrays. This was not the case for data obtained using arrays with less than 10 measurement positions.

For arrays with less than 10 microphones, the major contribution to intra-site repeatability is from variations in sound power determination resulting from inadequate spatial sampling, with minimal contribution from repeatability uncertainties and from variations resulting from using different measurement sites.

11.1.3 Reproducibility uncertainty

Standard deviations of reproducibility are so similar to those for intra-site repeatability, that when several Laboratories carry out a sound power determination using a specified procedure,

the measurement uncertainties involved are not statistically significantly different from those associated with measurements carried out by a single Laboratory.

The magnitude of reproducibility standard deviations is dependent not only on the number of microphone positions in the array and Directivity Index of the noise source but on the distribution of the microphones. It is clear, therefore, that for the purposes of estimating levels of reproducibility uncertainty, a knowledge of only the number of microphones is not sufficient.

Standard deviations of reproducibility calculated from data obtained from the programme of inter-laboratory measurements are similar to the measurement uncertainties published in Reference 8. In fact, values from Reference 8 are generally slightly larger and so, standard deviations of reproducibility based on data from reference 8 may over-estimate actual values and will, therefore, be suitable for inclusion in international sound power standards.

Assuming the microphone positions are distributed evenly on the enveloping surface, the 10-microphone array provides the smallest values of reproducibility, followed by the 7-microphone array, the 6-microphone array, the 4-microphone array and the 3-microphone array with the largest values of reproducibility provided by the single microphone.

For the purposes of inclusion in an international standard that is concerned with the determination of sound power level, standard deviations of reproducibility should be based on data obtained using actual machines.

The majority of machines have a Directivity Index between 1 dB and 3 dB.

It is proposed that if a machine has a particularly low value of Directivity Index (e.g. a reference sound source) then reproducibility values corresponding to a Directivity Index of 1 dB may be assumed. If on visual inspection a machine is not obviously highly directional (the case for the vast majority of machines) then a medium value of reproducibility corresponding to a Directivity Index of 3 dB may be assumed. If the machine has some obvious directionality components then high reproducibility values corresponding to a Directivity Index of 5 dB may be assumed. For even higher values of Directivity Index the 10-microphone array should be used and reproducibility values for a Directivity Index of 5 dB assumed.

A procedure is proposed that, for a given value of Directivity Index, will enable the user of a standard to easily assess how many microphone positions are required in the array to obtain a required value of reproducibility, or to assess the reduction in reproducibility that will be achieved by increasing the number of microphone positions. The following Standard deviations of reproducibility (expressed in dB) for inclusion in an international standard are proposed.

Number of microphones	Directivity Index (dB)		
	1	3	5
10	0.4	0.7	1.0
7	0.4	0.8	1.1
6	0.5	0.9	1.3
4	0.6	1.2	1.8
3	0.9	1.8	2.7
1	1.3	2.3	3.3

Values of the correction (assessed using ISO 4871) to allow for uncertainties in sound power levels determined using the 10-microphone array of ISO 3744, will be approximately 1 dB lower if the reproducibility uncertainties recommended in this report are used instead of the values given in ISO 4871.

11.2 ONE-THIRD OCTAVE-BAND RESULTS

Reproducibility uncertainties associated with a single microphone sound power determination are very large and vary considerably with one-third octave-band frequency, especially for a noise source that has a high Directivity Index.

For a machine with a low directivity index, reproducibility standard deviations are generally less than 1 dB for all frequency bands and microphone arrays.

For a machine with a medium value of Directivity Index, reproducibility standard deviations vary slightly from band to band and between arrays but are generally less than about 2 dB for all microphone arrays.

For a machine with a high Directivity Index, the standard deviations are generally less than about 3 dB, but with a marked variation between the different arrays.

For the purposes of an international standard it is suggested that a 10-microphone array should be specified when considering one-third octave-band sound power levels and a value of reproducibility standard deviation of 1.5 dB across the frequency range from 50 Hz to 10 kHz should be adopted.

12. ACKNOWLEDGEMENTS

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APPENDIX 1 “AS MEASURED” SOUND PRESSURE LEVEL DATA

This Appendix contains 36 Tables in three groups of 12. Each Table lists the sound pressure levels measured at each of the twenty microphone positions described in Table 1. The first group of twelve, Tables A1.1 to A1.12 list data for the reference sound source, the second group of twelve, Tables A1.13 to A1.24 list data for the generator and the third group of twelve, A1.25 to A1.36 list data for the box source. In each group of twelve Tables the first three contain data from Laboratory 1, the second three from Laboratory 2, the third three from Laboratory 3 and the last three from Laboratory 4.

Table A1.1 As measured sound pressure level data for the reference sound source, Laboratory 1, first determination

Freq band	ISO 3744 microphone positions (see Table 1)																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A-wt	83.65	84.36	83.77	84.66	84.34	84.57	83.37	83.56	83.7	83.18	83.65	83.96	84.26	84.17	84.59	84.52	83.25	83.58	83.35	82.81
50	71.12	71.71	71.17	72.04	71.17	71.52	69.03	69.75	68.88	72.25	71.54	72.06	71.64	71.61	70.72	70.88	70.08	68.58	68.23	58.87
63	70.18	71.19	70.74	70.48	70.2	71.33	71.05	68.86	68.65	63.19	70.65	71.02	70.91	70.2	70.55	69.8	68.58	68.32	67.66	59.38
80	70.93	72.62	72.51	71.52	71.8	71.33	71.87	68.67	69.52	60.82	71.92	72.11	73	70.84	72.08	70.86	69.52	69.07	68.79	59.71
100	72.76	72.01	72.44	71.42	71.38	71.02	69.21	69.35	72.58	61.85	71.19	70.95	71.21	70.84	70.6	71.4	68.06	69.68	69.12	60.68
125	71	71.02	70.93	70.13	70.46	70.51	68.81	68.77	68.23	62.82	70.55	70.91	70.84	70.2	70.84	70.3	67.85	68.74	67.76	62.16
160	70.84	70.93	70.39	69.99	70.06	69.8	68.18	69.19	67.9	63.9	69.99	70.77	70.88	69.75	70.27	69.94	67.76	67.54	67.73	63.33
200	70.86	71.02	70.37	69.68	69.45	69.64	68.04	67.64	66.44	63.69	70.58	71.21	70.84	68.67	69.92	69.68	66.09	66.81	66.63	63.03
250	70.98	71.4	71.09	69.57	68.98	69.43	67.12	66.51	66.51	64.93	70.53	71.24	71.09	69.26	69.43	69.12	65.76	66.41	66.16	64.79
315	71.12	71.78	71.09	69.66	69.26	69.43	66.6	65.94	66.3	66.11	70.74	70.98	71.19	69.68	69	69	65.57	66.79	65.73	65.64
400	71.75	72.67	72.18	70.01	70.15	69.52	66.74	66.49	66.79	66.49	72.08	72.18	71.87	69.94	69.68	69.47	66.23	66.51	66.27	65.38
500	71.19	72.53	72.08	69.07	68.7	68.11	65.69	66.49	65.66	67.38	71.38	71.85	71.87	67.52	69.57	68.41	65.54	65.87	65.31	67.68
630	72.25	73.09	72.86	67.64	67.17	67.12	67.85	68.25	69.43	71.71	71.82	72.29	71.99	67.21	67.78	66.74	68.95	68.86	68.39	70.98
800	73.66	74.15	73.54	66.2	65.69	66.09	71.12	71.75	72.46	73.35	73.16	73.73	72.95	66.06	66.25	65.31	71.99	72.13	71.52	73
1000	74.27	74.88	73.47	68.72	69.24	67.66	73.28	74.27	73.56	72.86	74.43	74.03	74.74	67.78	68.13	68.53	73.85	74.6	73.96	72.51
1250	74.98	75.45	73.82	73.61	73.61	75.12	74.72	73.07	73.63	76.86	74.58	74.74	76.43	74.67	74.86	74.22	72.11	73.05	72.91	76.32
1600	72.86	74.79	73.14	78.1	77.14	76.67	72.86	73.4	74.86	74.27	72.06	72.44	71.05	76.81	77.26	77.16	73.54	73.42	73.78	73.99
2000	69.71	69.12	69.31	75.38	75.09	76.34	74.53	74.95	74.93	72.95	67.47	69.85	71.71	75.21	75.49	75.52	75.14	75.16	74.9	72.86
2500	66.86	68.04	68.13	71.82	71.66	71.31	71.75	72.04	71.99	70.65	66.89	69.47	69.19	71.42	71.64	71.54	71.38	71.73	71.59	70.08
3150	70.6	71.24	72.27	73.66	73.73	73.82	71.28	71.33	71.24	67.85	72.48	72.84	72.04	73.49	73.8	74.55	71.19	71.33	71.17	67.66
4000	73.14	73.42	73.96	73.14	73.16	73.23	71.4	71.87	71.19	67.4	74.08	73.66	73.92	72.55	73.19	73.07	71.09	71.4	71.45	66.98
5000	72.62	73.09	72.32	71.38	71.19	71.19	69.87	70.44	69.68	66.18	72.44	72.29	72.81	70.69	71.42	71.33	69.57	70.11	69.5	65.94
6300	69.78	70.2	69.9	70.22	70.08	70.13	68.46	68.7	68.41	63.8	69.31	70.06	70.77	69.5	70.34	70.15	67.97	68.58	67.85	63.47
8000	66.89	67.87	68.41	68.25	68.37	68.18	66.93	67.03	67	61.57	67.83	68.13	68.32	67.71	68.58	68.44	66.44	67	66.79	61.17
10000	65.22	66.09	65.94	65.92	65.71	65.69	64.58	64.74	65	59.59	65.22	65.83	66.16	65.1	65.97	65.59	64.13	64.74	64.39	59.03

Table A1.2 As measured sound pressure level data for the reference sound source, Laboratory 1, second determination

freq band	ISO 3744 microphone position (see Table 1)																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A-wt	83.39	84.76	84.17	84.71	84.36	84.92	83.44	83.47	83.61	82.48	84.26	84.41	83.96	84.83	84.76	84.43	83.35	83.63	83.42	82.92
50	71.05	71.28	72.06	71.94	71.14	72.29	68.39	68.77	68.77	60.02	72.22	71.61	71.31	71.19	71.47	70.72	68.32	67.73	68.48	60.02
63	69.9	70.67	71.49	71.05	70.48	70.44	68.2	68.23	67.9	61.52	71.24	70.93	71	70.95	71.24	70.11	68.08	68.27	68.2	61.05
80	71.54	71.82	73.16	72.36	72.06	72.06	69.14	68.77	68.91	60.98	72.53	72.79	72.46	71.99	73.09	71.21	69.52	68.6	69.03	60.94
100	70.91	71.05	71.33	71.21	70.81	72.79	68.3	68.32	68.27	61.5	71.09	71.33	70.88	72.13	71.28	70.11	68.39	68.58	67.99	61.95
125	70.55	71.02	71.17	70.65	70.27	71.21	69.31	68.32	67.68	62.37	70.86	70.95	70.72	70.91	70.6	69.97	68.04	68.2	68.06	62.35
160	69.87	70.67	70.77	69.94	69.52	70.86	68.2	67.47	67.24	63.4	70.81	70.67	70.01	70.39	70.27	69.21	67.92	68.46	67.66	63.29
200	70.18	70.88	70.69	69.71	69.43	70.55	66.81	66.77	66.65	63.12	71	70.39	70.37	70.18	69.66	69.31	67.07	67.24	66.34	63.12
250	70.77	71.19	71.21	69.82	69.66	69.94	65.99	66.13	65.92	64.23	71.05	71.49	71.02	70.01	69.52	69.97	65.92	66.3	65.45	64.35
315	70.55	70.86	70.81	69.78	69.78	69.19	65.07	66.2	65.59	65.38	70.93	70.86	70.98	70.18	69.73	70.04	65.19	64.79	64.7	65.97
400	71.49	72.29	72.13	69.47	69.66	70.15	65.92	66.6	66.23	65.19	72.15	72.29	72.22	70.08	69.82	69.31	66.18	65.31	66.09	66.11
500	70.93	72.15	71.4	68.13	68.7	69.66	66.65	66.04	65.47	67.87	71.61	71.87	71.73	69.82	68.32	68.39	66.46	66.77	66.34	67.33
630	71.57	72.22	72.48	67.73	67.8	66.89	68.27	68.32	68.7	70.55	72.36	72.22	72.58	68.32	67.94	67.66	68.01	68.2	68.6	71.07
800	73.02	73.54	74.08	67	66.23	66.77	71.89	71.73	72.25	72.36	74.11	73.75	73.05	67.92	65.92	66.04	71.71	71.47	72.11	72.91
1000	73.82	75.63	74.34	69.97	67.87	66.89	73.54	73.19	73.54	72.06	74.62	75.63	73.96	67.31	68.08	67.76	73.89	73.99	73.66	72.53
1250	72.79	77.07	75.68	75.14	74.22	74.2	73.47	73.68	73.38	75.92	75.16	75.75	75.96	72.84	74.93	74.18	73.19	73.26	72.72	76.39
1600	71.02	74.72	73.38	77.3	76.72	76.93	73.99	74.03	74.69	73.94	74.55	74.83	72.06	77.33	76.97	76.83	73.19	74.18	74.06	74.22
2000	67.21	74.48	70.51	74.93	75.68	76.93	74.62	74.95	74.72	72.22	71	73.02	71.57	76.53	75.77	75.63	74.67	75.23	75.23	72.72
2500	68.7	69.43	67.31	71.82	71.4	72.06	71.71	71.49	71.94	70.01	67.59	69.35	69.35	73.38	72.2	71.92	71.94	71.78	71.61	70.91
3150	73.82	69.24	70.95	74.41	73.82	74.22	71.61	71.42	71.61	67.71	70.69	68.93	70.37	73.38	74.41	73.99	71.21	71.54	71.4	67.76
4000	74.74	69.52	73.66	73.19	73.12	74.39	71.47	71.47	71.78	67.26	73.52	71.38	73.19	74.06	73.68	73.45	71.71	71.73	70.84	67.66
5000	70.81	72.76	73.28	71.66	71.17	71.85	70.11	69.78	69.61	65.83	73.49	72.79	72.76	71.78	71.75	71.21	69.97	70.27	69.45	66.3
6300	68.84	72.36	71.33	70.69	70.04	70.39	68.2	68.32	68.37	63.22	70.81	71.59	70.48	70.55	70.6	69.87	68.16	68.72	68.06	63.85
8000	67.97	68.04	67.59	68.93	68.27	68.7	66.81	67.07	67.07	61.33	67.36	66.74	67.36	68.7	68.77	68.2	67.07	67.14	66.81	61.57
10000	64.74	65.26	66.13	66.04	65.59	65.92	64.23	64.44	64.49	58.63	65.97	65	65.52	65.87	65.97	65.47	64.25	64.67	64.35	59.01

Table A1.3 As measured sound pressure level data for the reference sound source, Laboratory 1, third determination

freq band	ISO 3744 microphone position (see Table 1)																			
	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20
A-wt	83.87	84.1	83.65	84.41	84.64	84.76	83.58	83.87	83.84	82.12	83.56	83.63	84.01	84.74	84.17	84.5	83.68	83.37	83.42	82.12
50	71.17	71.07	71.4	71.24	71.82	71.4	68.84	69.21	70.25	60.11	71.54	71.68	71.33	72.04	72.25	70.74	69.14	68.3	68.6	60.11
63	70.88	70.81	70.6	70.27	71.21	70.72	68.74	68.41	70.62	58.28	70.32	70.65	70.55	70.48	70.27	69.87	68.32	67.73	67.21	58.28
80	71.49	72.13	72.53	71.92	72.36	71.54	70.04	69.21	70.22	60.49	71.09	71.94	72.74	71.78	71.71	71.57	70.25	68.46	68.67	60.49
100	71.09	70.62	70.67	70.88	71.4	70.25	69.1	68.67	68.88	60.91	70.88	70.51	70.88	71.33	70.93	70.98	68.81	68.48	68.06	60.91
125	70.48	70.69	70.37	70.48	70.98	70.53	69	68.18	68.39	61.9	70.11	70.69	70.72	70.77	70.18	70.18	68.39	68.06	67.8	61.9
160	69.73	70.72	70.32	70.25	70.01	70.39	68.27	67.52	68.2	62.91	69.94	70.04	70.01	70.39	70.32	69.43	67.76	68.16	67.33	62.91
200	70.04	71.31	70.46	69.4	69.9	70.08	67.17	66.96	67.47	63.17	70.34	70.62	70.84	70.37	69.31	69.61	67.26	66.6	66.77	63.17
250	70.55	71.14	70.79	69.1	69.47	69.82	65.99	66.34	66.46	64.25	70.67	70.95	71.33	69.66	68.58	70.01	66.23	65.92	65.54	64.25
315	71.14	71.57	70.67	69.05	69.52	70.08	65.31	65.45	66.18	65.29	70.77	70.86	71.49	69.97	67.94	69.78	65.29	64.96	65.03	65.29
400	71.59	71.71	71.21	70.44	70.51	69.57	66.86	66.46	67	64.91	71.21	71.54	71.73	70.37	69.19	68.91	66.6	65.14	65.9	64.91
500	71.71	71.94	72.06	68.2	68.32	68.18	65.76	66.44	65.54	66.89	71.17	71.82	72.15	68.98	69.1	68.27	66.6	66.01	66.11	66.89
630	72.11	72.06	72.15	66.81	67.36	67.76	67.97	69.05	68.58	70.51	71.82	72.36	72.01	68.39	66.09	66.44	68.74	68.13	68.48	70.51
800	72.79	73.38	73.33	65.99	66.6	66.7	71.17	72.29	72.13	72.48	73.09	74.01	73.09	67.45	65.76	65.8	72.32	71.38	71.99	72.48
1000	72.67	75.07	73.75	68.53	68.32	67.43	73.63	74.62	73.89	71.94	73.49	74.25	74.62	67.61	68.04	68.72	73.75	73.4	74.22	71.94
1250	73.82	75	74.79	75.54	74.79	74.22	74.29	73.54	74.03	75.38	74.62	75.16	75.33	73.56	74.58	75.23	73.28	73.28	73.12	75.38
1600	73.56	72.67	72.48	76.76	77.49	76.95	72.62	74.01	73.99	73.56	71.94	73.33	69.97	77.19	76.57	77.12	74.34	73.78	73.85	73.56
2000	71.21	71.05	69.24	74.74	75.07	76.03	74.95	75.23	75.33	72.01	69.47	70.37	70.11	76.46	74.62	74.72	74.9	74.67	74.79	72.01
2500	69.1	68.08	68.16	71.66	71.75	72.53	72.44	72.11	72.25	69.43	68.77	66.23	68.91	72.32	71.38	71.61	71.94	71.66	71.73	69.43
3150	72.79	71.57	71.49	73.94	74.22	74.22	71.66	72.11	71.71	67	72.32	68.93	72.98	73.68	73.87	74.29	71.75	71.68	71.4	67
4000	74.72	74.03	73.4	73.02	73.23	74.22	72.2	71.89	72.22	66.65	73.89	72.48	74.5	73.89	73.16	73.23	71.87	71.73	71.38	66.65
5000	72.22	73.23	72.53	71.33	71.68	71.78	70.51	70.27	70.04	65.17	72.04	72.58	72.48	71.78	71.4	71.4	70.18	70.22	69.45	65.17
6300	68.91	70.04	70.25	70.01	70.22	70.11	68.32	68.32	68.46	63.03	69.31	69.97	69.78	70.15	69.97	69.94	68.53	68.2	67.8	63.03
8000	67.92	68.06	68.04	68.39	68.77	68.41	67.07	67	67.52	60.58	67.97	66.34	68.81	68.41	68.39	68.32	67.14	66.86	66.74	60.58
10000	65.03	65.85	65.36	65.47	65.8	65.59	64.58	64.35	64.93	58.32	64.67	64.82	65.59	65.76	65.4	65.45	64.58	64.42	64.16	58.32

Table A1.4 As measured sound pressure level data for the reference sound source, Laboratory 2, first determination

freq band	ISO 3744 microphone position (see Table 1)																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A-wt	83.5	83.5	83.6	83.8	84	84.3	83	82.9	82.8	82.5	83.4	83.5	83.7	84.1	84.4	84	82.7	82.8	82.9	82.4
50	71.1	70.8	71.4	72.3	70.9	71	68.5	69.4	69.4	58.7	71.5	71.6	71.6	71.2	71.2	69.9	68.2	68.2	68.3	58.8
63	70.1	70.4	70.8	70.2	69.5	69.9	67.5	68.4	68	59.6	70.3	70.3	70.5	69.7	69.9	69.4	67.5	67.3	67.4	58.9
80	70.7	71.1	72.6	70.9	72.4	69.9	69	68.2	68.1	60.2	70.6	71.5	72.9	70.5	72.2	71	69.3	68	68	59.3
100	70.5	70.7	70.7	69.9	70	69.5	67.3	68.1	67.6	60.4	70.1	70.5	70.6	69.6	69.8	69.9	67.6	67.2	67.6	59.7
125	70.5	70.6	70.4	69.4	70	69.3	67	67.7	67.5	61.4	70.1	70.1	70.3	69.5	69.2	69.6	67.5	67	67.1	61.3
160	70.6	70.7	70.4	69.6	70	68.7	67.1	68.1	67.6	63.2	69.6	70.1	70.6	69.8	69.1	69.9	67.7	66.3	67.2	62.9
200	70.6	70.7	70.5	69.6	69.5	69.1	66.5	67.2	66.9	63.2	69.9	70.8	70.5	69.4	69.3	69.8	66.9	66.4	67.1	63
250	70.6	71.1	70.5	69.3	69.2	68.9	65.9	66.6	66.4	64.2	70.2	70.7	70.6	69.5	69.1	69.5	66.4	66	66.4	64
315	70.8	71	70.8	68.9	69	68.8	65.4	65.8	65.8	65	70.5	70.7	70.7	68.9	68.7	69.1	65.5	65.4	65.7	64.8
400	71	71.6	71.5	68.8	68.8	68.4	64.9	65	64.8	65.6	70.9	71.2	71.3	68.7	68.9	68.8	65.1	64.8	64.9	65.4
500	71.3	72.2	72	68.3	68.4	67.8	65.4	65.4	65.2	67.6	71.3	71.8	71.9	68.2	68.4	68.1	65.3	65.3	65.6	67.3
630	71.8	72.5	72.4	66.7	67.2	66.3	68.2	67.9	67.5	71.2	71.6	72.1	72.3	67	67.1	67	67.6	68	68.2	71
800	73.3	73.5	73.7	65	65.2	65.3	71.6	71.4	71.3	73.4	73.1	73.3	73.5	65.6	65.4	64.8	71.1	71.4	71.7	73.3
1000	74	74.3	74.3	68	68	67.6	73.5	73.8	73.7	72.5	74.3	73.9	74.3	68.1	68.2	67.5	73.5	73.5	73.6	72.5
1250	75.4	75.2	75.1	74.3	74.3	74.7	73	72.8	73.1	75.8	75.3	75.1	75.9	74.6	75	74.1	72.8	73	72.6	75.6
1600	73	73.4	73.1	76.9	77.2	77.6	73.9	73.4	72.7	73.5	72.7	73.1	73.3	77.4	77.6	77	72.7	73.4	73.6	73.3
2000	69.7	69.8	69.7	74.3	74.8	74.8	74.3	74.2	73.9	71.6	68.8	69.5	70	74.8	74.7	74.6	74.2	74.2	74.4	71.7
2500	66	65.9	66.2	71.3	71.2	71.8	71.7	71.4	71.8	70.8	64.7	66.3	66.1	71.4	71.8	71.4	71.3	71.5	71.5	70.5
3150	69.2	68.6	69.4	72.6	72.7	73.3	70.7	70.5	70.4	66.9	70.3	69.5	68.8	72.9	73.2	73.2	70	70.2	70.7	66.8
4000	72.5	72	72.8	72.1	72.2	72.6	70.5	70.2	70.5	66.8	73.2	72.9	72.4	72.3	72.3	72.5	70.3	70.2	70.4	66.7
5000	72.2	72.2	72.6	70.1	70.3	70.8	68.9	69.2	68.9	65.2	72.3	72.3	72.3	70.2	70.8	70.9	68.9	69	68.9	65.1
6300	69.1	69.3	69.9	68.6	69.2	69.4	66.6	66.7	66.3	62.6	69.1	68.8	69.7	68.9	69.7	69	66.5	66.7	66.4	62.5
8000	66.6	65.8	66.8	66.8	67.3	67.6	65.2	64.9	65.1	60.6	66.8	66.5	66.4	67.2	67.9	67.3	65.1	65.1	64.9	60.6
10000	64.7	64.3	65.3	64.1	64.5	64.7	62.5	62.2	62.3	58.3	64.9	64.8	65	64.3	64.9	64.5	62.6	62.5	62.3	58.2

Table A1.5 As measured sound pressure level data for the reference sound source, Laboratory 2, second determination

freq band	ISO 3744 microphone position (see Table 1)																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A-wt	83.4	83.5	83.6	83.9	83.8	84.2	83	82.8	82.8	82.3	83.5	83.6	83.7	84.1	84	83.9	82.8	82.8	83	82.3
50	71.3	71.6	71.5	70.4	70.3	70.4	68.6	68.8	68.2	59.1	71.4	72	71.3	71.5	71.1	71.2	68.5	68.2	68	59.5
63	70	70.2	70	69.7	69.5	69.5	66.7	67.2	67.4	59.9	70	70.4	70.3	69.9	69.7	70.1	67.3	67.4	67.3	61
80	70.8	71.1	73	70.3	72.1	70.2	69	67.5	67.9	60.6	70.9	71.1	72.6	70.7	72.4	70.7	69.5	67.6	67.7	59.5
100	70.5	70.3	70.6	69.5	69.8	69.9	67.3	67.6	67.8	60	70.3	70.3	70.7	70	69.9	69.7	67.5	67.4	67.4	59.7
125	70.3	70.4	70.1	69.4	69.9	69.7	66.9	67.4	67.5	61.5	70.2	70.2	70.6	69.8	68.9	69.8	67.3	66.7	67.2	61.4
160	70.5	70.6	69.9	69.5	69.8	69	66.8	67.8	67.6	62.9	69.7	70.2	70.9	69.9	69.2	69.8	68.1	66.6	67.2	62.7
200	70.8	70.5	70.4	69.7	69.3	69.2	66.6	67.3	67.1	62.8	70.2	70.6	70.3	69.8	69	69.7	67	66.4	67.2	63.1
250	70.3	70.7	70.1	69.3	69.2	69.1	66.3	66.7	66.5	64.1	70.1	70.5	70.6	69.5	68.8	69.3	66.4	65.9	66.6	64.3
315	70.7	70.7	70.5	69	69	68.7	65.5	65.7	65.5	64.8	70.5	70.8	71	69.1	68.7	69	65.7	65.3	65.5	64.9
400	71	71.3	71.2	68.6	68.8	68.4	64.9	65	65.1	65.5	70.8	71.2	71.5	68.8	68.3	68.5	65.1	64.6	64.9	65.5
500	71.3	71.6	71.6	68.3	68.4	67.8	65.4	65.3	65.3	67.4	71.2	71.6	71.9	68.3	68.1	67.8	65.2	65.3	65.5	67.4
630	71.9	72.2	72.2	66.9	67	66.3	68.2	67.7	67.8	71.1	71.5	72.1	72.3	66.8	66.7	66.7	67.4	67.8	68	71
800	73.4	73.6	73.8	64.8	64.8	65.1	71.7	71.2	71.7	73.1	73.3	73.4	73.6	65.2	65	64.7	71.2	71.3	71.7	73.2
1000	74.1	74.4	74.5	67.8	67.5	68.1	73.6	73.8	73.6	72.3	74.5	74	74.3	68.4	68	68.3	73.8	73.5	73.7	72.2
1250	75.2	75.4	75	74.4	74.3	75.1	73.3	73	73	75.6	75.1	75.1	75.5	75	75.1	74.8	73.4	73.2	73.1	75.5
1600	73.1	73.6	73	77	76.8	77.1	73.6	73.2	73.1	73.3	72.9	73.2	73.6	77	77.1	76.5	72.3	73.3	73.4	73.4
2000	70	70.1	69.7	74.3	74.5	74.7	74.3	74.2	74.1	71.6	69	70	70.3	74.5	74	74.5	74.3	74.4	74.4	71.7
2500	66.2	66.2	66.4	71.6	71.2	71.7	71.7	71.3	71.5	70.6	64.9	66.8	66.5	71.4	71.8	71.1	71.6	71.2	71.6	70.6
3150	68.8	68.3	69.6	72.8	72.7	73.5	70.5	70.2	70.2	66.5	70	69.8	68.3	73	72.8	73.2	70	70	70.5	66.5
4000	72.3	72	73.1	72.3	72	72.3	70.3	70.4	70.4	66.2	73.2	73.1	72.2	72.2	72	72	70.4	70	70.5	66.2
5000	72.1	72.2	72.6	70.4	70.3	70.8	68.7	69.2	68.8	65	72.4	72.5	72.7	70.3	70.3	70.5	68.9	68.8	68.7	65
6300	69	69.1	69.7	69.2	69.3	69.6	66.6	66.8	66.2	62.1	69.4	68.7	70.4	69.2	69.3	69.1	66.5	66.4	66.3	62.1
8000	66.3	65.8	67.1	67.2	67.2	67.7	65	65.1	64.9	60	66.9	66.6	66.6	67.3	67.5	67.3	65.2	64.9	64.8	60.1
10000	64.5	64.3	65.3	64.7	64.7	64.9	62.6	62.4	62.3	57.4	65	65	65.5	64.6	64.7	64.4	62.6	62.4	62.2	57.4

Table A1.6 As measured sound pressure level data for the reference sound source, Laboratory 2, third determination

freq band	ISO 3744 microphone position (see Table 1)																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A-wt	83.2	83.4	83.6	83.7	83.7	84.1	83	82.9	82.9	82.3	83.3	83.5	83.7	83.9	83.9	83.8	82.9	82.9	82.9	82.3
50	71.4	71.4	71.1	70.5	71	71.7	68.4	68.4	69.4	59.8	71.4	72.1	71.7	70.3	70.6	71	68.5	68.8	68.3	58.4
63	69.9	70.8	70.1	69.4	69.9	69.8	67.2	67.5	68.1	59.5	70.4	70.7	70.6	69.6	69.6	69.9	67.2	67.3	66.9	58.6
80	70.6	71.3	72.7	70.6	72.1	69.9	69.3	67.6	68.2	59.6	70.6	71.6	72.6	70.3	72.2	71	69.8	67.6	68	59
100	70.2	70.8	70.7	69.7	69.8	69.5	67.3	67.8	68	60.4	70.4	70.8	70.7	69.8	69.7	69.9	68.1	67.7	67.8	59.8
125	70.3	70.6	70.4	69.2	69.9	69.4	66.9	67.6	67.5	61.1	70.1	70.6	70.6	69.3	69.5	70	67.7	66.9	67.4	61.5
160	70.4	70.9	70.4	69.3	69.8	68.7	66.6	67.9	67.6	63.1	69.7	70.5	70.6	69.5	69.2	69.8	68	66.4	67.4	62.9
200	70.7	70.9	70.5	69.7	69.5	68.9	66.7	67.2	66.9	62.8	70.3	70.8	70.4	69.6	69.3	69.5	67.1	66.2	67.4	62.8
250	70.6	71	70.4	69.2	69.2	68.8	66.3	66.7	66.6	64.1	70.2	70.6	70.6	69.2	69.5	69.3	66.6	66	66.6	64.1
315	70.8	71	70.8	68.7	69.1	68.5	65.5	65.7	65.7	64.8	70.6	70.8	70.8	68.9	69	68.9	65.6	65.3	65.7	64.9
400	71	71.6	71.5	68.5	68.6	68	64.9	65	65	65.6	70.8	71.3	71.3	68.5	68.6	68.6	65.2	64.8	65.1	65.5
500	71.4	72	71.9	68	68.3	67.5	65.5	65.2	65.4	67.4	71.1	71.7	71.7	68.1	68.2	67.9	65.6	65.4	65.5	67.6
630	71.8	72.4	72.4	66.7	66.9	66	68.3	67.6	67.8	70.9	71.6	72	72.2	66.6	66.9	66.6	67.9	68.1	68.1	71.1
800	73	73.7	73.7	64.6	64.8	65	71.7	71.1	71.6	73.1	73.3	73.3	73.7	65.2	65.1	64.6	71.4	71.6	71.5	73
1000	73.7	74.4	74.4	67.5	67.7	68.2	73.6	73.7	73.8	72.2	74.3	73.9	74.4	68.1	68	67.9	73.8	73.7	73.6	72.2
1250	74.7	75	74.7	74.3	74.2	75.1	73.4	73.2	73.2	75.5	74.9	75	75.6	74.7	74.8	74.7	73.3	73.1	73	75.5
1600	72.4	72.8	72.7	76.8	76.7	77	73.6	73	73.1	73.2	72.5	72.9	73	77	76.9	76.7	72.9	73.7	73.4	73.2
2000	68.9	69.2	69.2	74	74.1	74.2	74.2	74.3	74.1	71.7	68.6	69.4	69.7	74.2	74	73.9	74.2	74.3	74.5	71.8
2500	66.4	66.3	66.6	71.4	71	71.6	71.8	71.6	71.7	70.7	65.2	66.8	66.6	71.4	71.4	71.2	71.9	71.5	71.4	70.8
3150	69.8	69.5	70.1	72.7	72.7	73.5	70.7	70.5	70.6	66.6	70.2	70.3	69.6	72.9	73	73.1	70.5	70.3	70.5	66.8
4000	72.9	72.7	73.1	72.2	71.8	72.3	70.3	70.5	70.4	66.4	73.1	73.3	72.9	72.1	71.9	72.2	70.5	70	70.5	66.6
5000	72.1	71.9	72.4	70.2	70.2	70.7	68.7	69.3	68.8	64.5	72.2	72.3	72.5	70.3	70.7	70.4	68.9	68.9	69	64.5
6300	68.4	68.4	69.4	68.7	68.9	69.1	66.4	66.6	66.1	61.7	69.2	68.5	69.6	68.9	69.4	68.7	66.4	66.4	66.6	61.9
8000	66.5	66.1	67.1	66.8	66.8	67.4	64.6	65.1	64.9	59.6	66.9	66.9	67	67	67.5	66.8	65.2	65	65.1	59.8
10000	64.3	64.3	65.1	64.1	64	64.4	62.1	62.4	62.2	57	65	64.7	65.1	64.1	64.6	63.7	62.5	62.3	62.5	57.2

Table A1.7 As measured sound pressure level data for the reference sound source, Laboratory 3, first determination

freq band	ISO 3744 microphone position (see Table 1)																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A-wt	84.9	84.4	84.4	84.7	84.9	84.3	83.7	84	83.9	83.3	84.3	84.3	84.6	84.3	84.5	84.6	83.8	83.5	83.4	83.2
50	72.7	72.1	72.4	71.4	71.3	71.7	68.4	69.3	68.8	57.6	72	72.7	73	70.5	71.6	71.5	68.9	69.2	68.3	57.7
63	71	70.2	70.9	69.9	70.2	69.6	67.2	67.7	67.8	58.4	70.5	70.9	71.8	69.5	70	70	68.3	67.9	68	58.3
80	72.5	72.5	71.9	71.7	71.4	71.2	69.1	68.9	69	59.6	72.4	72.6	73.3	70.6	71.6	71.4	69.4	69.1	68.3	60
100	72	70.8	71.4	70.5	70.7	70.7	68.4	68.6	68.9	60.5	71.6	71.8	71.7	69.8	70.4	71.2	68.6	68.6	68.2	60.6
125	71.6	70.3	70.9	70	70.2	70.2	68	68.2	68.2	62.4	71.1	70.7	71.6	69.3	69.8	70.8	68.5	68.2	68.2	62.5
160	72.1	70.1	71.1	70.5	70.1	69.8	68.7	68.4	67.7	63.4	71	71.5	71.5	69.1	70.5	70.8	67.4	68.1	68.2	63.6
200	71.5	70.5	71.4	70.2	69.9	69.9	68.2	68.1	67.9	63.8	71.3	71.6	71.4	69.6	70.2	70.4	67.5	67.8	67.9	63.3
250	71.8	71	71.3	70.1	70.4	69.7	67.5	67.3	67.5	64.8	71.3	71.4	71.8	69.5	70.2	70.2	67.4	68	67.7	64.9
315	71.7	71.2	71.4	69.8	69.7	69.3	66.9	66.8	67	65.8	71.3	71.5	71.8	69.4	69.7	69.8	66.8	66.8	66.7	65.8
400	72.2	71.7	71.7	69.6	69.6	69.4	66	66.2	66	66	72	71.8	72.1	69.4	69.4	69.7	66.1	65.9	65.9	66.3
500	72.7	71.8	72.3	68.6	68.7	68.4	65.8	66.1	66.2	67.7	72.1	72.3	72.4	68.5	68.5	68.7	65.8	65.6	65.5	67.9
630	72.9	72.2	72.7	66.8	66.9	66.7	67.7	68.5	68.3	71.3	72.4	72.5	72.6	66.6	66.8	66.7	68.1	67.4	66.9	71.3
800	74.5	74.2	74	66.3	66.7	66.2	71.4	72.2	72	73.8	73.9	74.1	74.5	66.5	66.3	66.1	71.9	71.2	70.8	74
1000	75.7	75.4	74.9	68.2	68.4	67.4	74.4	74.6	74.3	73.1	74.9	74.8	75.5	66.7	68.4	68.4	74.6	74.1	74.1	73
1250	77.4	76.5	76.5	74.4	74.6	73.3	73.5	73.6	73.6	76.9	76.4	76.3	76.4	73	74.1	74.2	73.9	73.9	74	76.9
1600	76.9	75.7	75.8	78.2	78.5	77.8	74.4	75	74.8	75.8	75.7	75.8	75.3	77.7	77.9	77.8	74.5	73.4	73.2	75.6
2000	74.2	72.3	72.6	75.3	75.4	75.2	74.9	74.9	75.2	72.6	72.1	72.6	71.6	75.8	75	74.9	75.1	74.6	74.6	72.6
2500	71.1	67.8	68.3	72.5	72.5	72.2	72.5	72.9	72.5	70.3	68.2	68.1	67.2	72.2	72.2	72.3	72.5	72.5	72.7	70.4
3150	66.7	66.4	66.4	73.9	74	73.4	71.2	71.6	71.3	68.1	66.7	66.3	68.5	73.2	73.7	74	71	71.2	70.9	68
4000	66.5	71	70.2	72.9	72.8	72.7	71.6	71.6	71.5	66.3	70.9	70.9	72.3	72.8	72.5	73.1	71.2	71.7	71.6	66.2
5000	70.6	73.4	73	71.9	71.9	71.4	70.8	70.9	70.6	66.2	73	73	73.9	71.5	71.6	72	70.5	70.6	70.6	66.4
6300	71.7	72.2	72.4	70.5	70.9	70.2	69.1	69.4	69.4	63.7	72	71.8	72.3	70.2	70.5	70.7	69.2	69.2	69.3	63.8
8000	69.3	66.7	67.8	68.6	69	68.3	67.7	67.6	67.8	62.3	67.3	66.8	67.8	68	68.7	69.1	67.8	67.6	67.8	62.7
10000	65.3	65.7	65.8	66.3	66.6	66	65.7	65.5	65.8	61.3	65.9	65.7	66.8	65.7	66.2	66.4	65.9	65.4	65.6	61

Table A1.8 As measured sound pressure level data for the reference sound source, Laboratory 3, second determination

freq band	ISO 3744 microphone position (see Table 1)																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A-wt	85.2	84.5	84.2	85	84.7	84.2	83.7	84	83.9	83.3	84.3	84.4	84.6	84.3	84.6	84.6	83.8	83.4	83.3	83.3
50	72.6	72.1	72	71.6	70.9	71.5	68.8	68.9	68.9	57.8	72.1	72.6	72.9	70.6	71.5	71.8	69.4	68.9	69	57.9
63	70.8	70.4	70.6	69.9	70.3	69.8	67.9	68.5	68.4	58.8	70.5	70.7	71.7	69.5	70.2	70.6	68.2	68.7	68.3	58.6
80	73	72.5	71.9	71.1	71.5	71.2	68.8	68.9	69.3	60.1	72.3	72.8	72.9	70.8	71.4	71.5	69.4	69.2	68.8	60
100	71.8	70.9	71.4	70.5	70.6	70.5	68.4	68.8	68.7	61.6	71.4	71.7	72	69.7	71	71	68.6	68.4	67.9	60.8
125	71.9	70.6	70.6	70.3	70.2	70.1	67.9	68.4	67.8	62.5	70.8	71.3	71.4	69.1	70.7	70.9	68.2	68.2	68.5	62.4
160	72.1	70.5	71	70.5	70	70	68.5	68.5	67.4	63.7	70.8	71.6	71.5	69.1	70.8	70.6	67.6	67.8	68.1	63.8
200	71.6	70.8	71.3	70.3	69.7	69.8	68.1	67.8	67.7	63.8	71	71.5	71.5	69.4	70.7	70.6	67.2	68.1	67.8	63.7
250	71.8	71.2	71.3	70	70.1	69.7	67.4	67.3	67.2	65	70.9	71.3	71.8	69.2	70.2	70.1	67.2	67.5	67.3	65.1
315	71.7	71.6	71.5	69.8	69.5	69.2	66.9	66.5	66.6	65.6	71	71.5	71.9	69.3	70.2	69.8	66.6	66.8	66.8	65.7
400	72.3	71.8	71.8	69.6	69.5	69.1	66	66	66	66.1	71.7	72	72.2	69	69.7	69.8	65.8	66.1	66	66.3
500	72.7	72.3	72.3	68.6	68.5	68.2	65.7	66.1	66	67.7	72	72.1	72.8	68.3	68.8	68.7	65.8	65.7	65.5	67.7
630	73	72.4	72.4	66.7	66.7	66.7	67.9	68.6	68.3	71.3	72.5	72.4	72.9	66.5	67.4	66.6	68.2	67.4	66.7	71.2
800	74.7	74.2	74	66.2	66.5	66.3	71.5	72.1	71.8	74	74	74	74.3	66.2	66.6	66.2	71.9	71.2	70.6	73.9
1000	76.2	75.4	74.8	68.9	68.1	67.1	74.4	74.7	74.3	73	75.1	75	75.4	66.8	68.1	68.6	74.7	74.2	74.2	73.1
1250	77.8	76.3	76.1	74.8	74.4	73.1	73.4	73.7	73.5	77	76.4	76.4	76.4	73.2	73.8	74.4	73.8	73.8	73.9	77.1
1600	77	75.9	75.6	78.6	78.3	77.5	74.6	75.1	74.9	75.8	75.6	75.8	75.4	77.8	77.9	78	74.4	73.5	73	75.7
2000	74.3	72.6	72.3	75.6	75.3	75.2	74.9	75.1	75.4	72.7	71.9	72.7	71.9	75.6	75.3	75	75.3	74.3	74.5	72.6
2500	71.4	68.1	68.1	72.8	72.3	72.2	72.6	72.9	72.6	70.4	67.7	68	67.4	72.1	72.4	72.2	72.5	72.5	72.5	70.2
3150	66.4	66.2	66.1	74.2	74	73.3	71.2	71.5	71.3	68	67.6	66.4	67.8	73.1	73.8	73.7	71	71.3	71	68.1
4000	67.4	70.7	69.7	73.1	72.8	72.6	71.6	71.6	71.6	66.3	71.9	70.8	71.8	72.8	72.9	72.9	71.3	71.6	71.5	66.4
5000	71.3	73.3	72.7	72	71.8	71.3	70.8	70.8	70.5	66.2	73.3	72.9	73.8	71.4	71.9	71.7	70.5	70.6	70.5	66.4
6300	71.8	72.6	72.4	70.8	70.8	70	69.2	69.4	69.4	63.9	71.6	71.9	72.8	70.1	70.8	70.6	69.2	69.1	69.2	64
8000	68.9	67.3	67.9	68.9	68.8	68.1	67.9	67.7	67.7	62.8	66.9	66.8	68.1	67.9	69	68.9	67.8	67.6	67.6	62.1
10000	65	65.8	65.7	66.4	66.4	65.8	65.8	65.5	65.7	61.6	66.1	65.7	66.8	65.5	66.6	66.2	65.9	65.4	65.5	61.3

Table A1.9 As measured sound pressure level data for the reference sound source, Laboratory 3, third determination

freq band	ISO 3744 microphone position (see Table 1)																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A-wt	84.9	84.5	84.4	84.7	84.7	84.1	83.8	84	83.9	83.3	84.3	84.3	84.5	84.3	84.7	84.7	83.7	83.5	83.4	83.4
50	73.1	72.3	72.2	71.7	71.4	70.9	68.7	69.1	69.1	58.4	72	72.1	73.1	70.4	71.3	71.3	69.1	69	68.8	57.6
63	70.8	70.5	70.7	70.1	70.2	69.3	67.5	68	67.8	60.2	70.7	70.1	71.5	69.4	70.2	70.6	68.2	67.8	67.8	58.5
80	72.6	72.6	72	72.2	71.3	71.3	68.6	68.8	69.4	60	72.3	72.2	73	70.8	71.3	72	69	69	68.2	60
100	72.2	71.4	71.2	70.6	70.6	70.2	68.2	69	69.2	60.8	71.1	71.2	71.7	69.7	70.5	71.3	68.3	68.4	68.2	60.2
125	71.8	70.8	70.9	70.2	69.9	69.7	68.2	68.2	68.6	62.4	70.3	70.9	71.4	69.2	70.4	70.6	67.8	68.1	68.7	62.2
160	71.9	70.9	71	70.6	69.7	69.7	68.6	68.2	67.5	63.6	70.7	71.2	71.1	68.9	70.3	70.5	67.4	67.6	68.2	63.8
200	71.6	71	71.4	70.5	69.5	69.9	68.2	68	67.7	63.7	71.1	71	71.2	69.3	70.3	70.4	67.3	68.2	67.7	63.3
250	71.9	71.2	71.3	70.2	69.9	69.8	67.6	67.2	67.3	65	70.9	71.3	71.3	69.3	70.2	70.2	67.1	67.5	67.6	65
315	71.8	71.5	71.2	69.6	69.7	69.5	67	66.9	67	66	71.1	71.4	71.5	69.3	70.1	69.7	66.4	67	66.9	65.8
400	72.4	71.9	71.8	69.8	69.3	69	66.2	66	66	66.2	71.5	71.7	72.1	69.1	69.5	69.4	66	66.2	66.1	66.2
500	72.9	72.3	72.3	68.5	68.5	68.2	65.9	66.2	66.1	67.7	71.9	72	72.2	68.1	68.8	68.4	65.7	65.7	65.5	67.9
630	73	72.5	72.6	66.9	66.7	66.8	67.9	68.5	68.3	71.3	71.9	72.3	72.6	66.5	67.4	66.5	68.1	67.5	66.9	71.4
800	74.5	74.3	74.2	66	66.5	66.2	71.4	72.1	71.9	73.9	73.7	73.9	74.5	66.4	66.6	66.2	72	71.2	70.8	74
1000	75.8	75.3	75.2	68.4	68.1	67	74.6	74.7	74.3	73	75	75.1	75.6	66.9	68.2	68.8	74.5	74.2	74.1	73
1250	77.2	76.3	76.6	74.4	74.3	72.9	73.6	73.6	73.6	77.2	76.4	76.4	76.4	73.2	73.9	74.6	73.8	73.7	74.2	77.1
1600	76.8	75.9	75.7	78.2	78.3	77.5	74.6	74.9	75	75.7	75.6	75.7	75.4	77.7	78.1	78.1	74.4	73.6	73.2	75.9
2000	74.2	72.5	72.3	75.4	75.2	75.1	75	75	75.3	72.7	71.9	72.7	71.9	75.6	75.4	75	75.1	74.5	74.6	72.6
2500	71.1	68	68.2	72.5	72.3	72.2	72.6	72.8	72.7	70.4	67.8	68.2	67.4	72.1	72.5	72.3	72.6	72.6	72.5	70.3
3150	66.8	66.5	66.6	73.9	73.9	73.3	71.2	71.5	71.4	68.1	67.6	66.4	67.7	73	73.9	73.9	71	71.3	71	68
4000	66.9	71.1	70.4	72.9	72.6	72.6	71.7	71.6	71.6	66.2	71.8	70.8	71.7	72.6	73.1	73	71.1	71.7	71.5	66.4
5000	70.9	73.5	73.1	71.8	71.6	71.2	70.8	70.9	70.6	66.5	73.2	73	73.7	71.4	72	71.9	70.5	70.6	70.5	66.1
6300	71.7	72.5	72.4	70.4	70.7	70	69.2	69.4	69.4	63.9	71.6	72	72.4	70	70.9	70.7	69.2	69.2	69.2	63.9
8000	69.5	67.1	67.6	68.5	68.7	68.1	67.8	67.6	67.7	62.9	66.9	67.1	67.8	67.8	69.1	68.9	67.7	67.6	67.6	61.9
10000	65.5	65.9	66.1	66.1	66.2	65.8	65.7	65.5	65.7	61.3	66	65.8	66.6	65.3	66.7	66.3	65.8	65.4	65.5	61.3

Table A1.10 As measured sound pressure level data for the reference sound source, Laboratory 4, first determination

freq band	ISO 3744 microphone position (see Table 1)																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A-wt	83.8	84.2	84.2	83.9	84.1	83.6	83.8	83.7	83.5	82.8	84.4	84.1	84.4	83.8	84.3	84.1	83.7	83.7	83.7	82.8
50	72.04	72.53	73	71.64	71.64	71.05	69.12	69.71	70.67	63.43	72.62	71.75	72.04	71.17	71.75	71.82	70.81	71.33	69.78	63.43
63	71.26	71.05	71.4	70.32	70.95	70.53	68.77	68.46	68.72	63	72.98	70.86	71	71.45	71.78	71.21	69.33	69.24	70.74	63
80	72.32	72.27	72.13	71.26	72.13	71.49	69.21	69.31	70.55	64.25	72.46	72.27	72.46	71.92	72.22	71.87	69	69.31	69.17	64.25
100	71.05	71.35	71	70.32	70.65	70.62	68.41	68.16	68.32	61.48	71.52	70.95	71.61	70.46	70.44	70.55	68.44	68.63	68.86	61.48
125	70.67	70.48	71.21	70.01	70.37	70.15	68.04	67.76	67.64	62.3	71.09	70.37	71.02	70.18	70.65	70.15	67.87	68.16	68.27	62.3
160	70.79	71.05	70.51	69.43	70.69	70.01	68.06	68.01	68.06	63.5	71.24	70.22	71.52	70.22	69.9	70.72	67.94	68.18	68.04	63.5
200	71.05	71	70.86	69.12	70.27	70.22	67.24	67.24	67.24	63.29	71	70.06	71.33	70.04	69.94	69.87	67.47	67.36	67.26	63.29
250	71.14	70.81	70.79	69.4	70.11	70.01	67.12	67.07	66.58	64.25	71.26	70.93	71.45	69.64	69.92	69.75	66.86	67.33	67.14	64.25
315	71.07	71.31	71.14	69.94	70.15	69.12	66.18	66.23	66.56	65.19	71.21	70.91	71.68	69.66	69.52	69.97	66.06	66.11	66.01	65.19
400	71.8	71.73	71.66	69.31	68.95	68.79	65.33	65.17	64.96	65.69	71.78	71.42	71.92	69.45	69.35	69.05	65.45	65.5	65.85	65.69
500	72.13	72.06	72.48	68.88	69.24	69.03	65.8	65.71	65.47	67.66	72.32	71.89	72.58	68.79	68.84	68.74	65.78	65.76	66.11	67.66
630	72.86	72.76	72.86	67.68	67.87	68.63	68.67	68.6	67.76	71.05	73.07	72.91	73.09	67.71	67.64	67.54	68.46	68.48	68.88	71.05
800	74.08	74.08	74.41	66.53	66.37	65.8	72.13	72.04	71.26	73.63	74.2	74.22	74.43	66.34	66.7	66.25	71.92	72.06	72.51	73.63
1000	75.02	74.79	75.45	68.08	68.86	68.16	74.06	74.06	73.78	73.09	75.45	74.93	75.16	68.25	68.95	69.14	74.18	74.34	73.71	73.09
1250	75.59	75.92	75.7	74.65	75.09	74.27	74.11	73.68	73.85	77.09	76.25	75.99	76.01	74.6	75.73	75.49	73.66	74.08	73.61	77.09
1600	72.88	74.15	73.78	75.42	75.35	74.81	74.39	74.39	73.42	74.15	74.01	74.29	73.38	75.05	75.61	75.26	74.22	73.87	74.58	74.15
2000	67.99	69.61	69.31	74.22	73.8	73.73	76.39	76.17	76.13	70.72	69.78	70.08	68.72	74.06	73.73	73.33	76.25	76.03	76.13	70.72
2500	65	66.01	65.12	71.66	72.01	71.57	72.2	72.36	72.27	68.88	65.85	65.85	66.32	71.66	72.22	71.99	72.22	71.99	72.22	68.88
3150	70.95	70.44	69.82	74.32	74.74	74.34	69.19	69.87	69.24	67.94	71.47	70.25	72.65	74.32	75.05	74.88	69.21	69.1	69.61	67.94
4000	73.75	74.03	73.42	71.87	71.92	71.99	69.05	69.35	69.35	67.07	74.29	73.05	74.6	71.85	71.82	71.82	69.17	69.73	68.81	67.07
5000	71.89	73.12	73.23	71.99	72.32	71.57	69.82	69.52	69.66	63.12	72.74	72.01	72.48	72.01	71.99	72.08	69.71	70.37	68.81	63.12
6300	69.52	70.11	70.79	69.35	69.9	69.21	69.57	69.97	69.24	62.86	70.13	70.27	70.18	69.21	69.94	69.97	69.66	69.1	69.73	62.86
8000	67.59	67.64	67.66	68.18	68.81	68.08	65.85	65.73	65.83	59.74	68.01	67.07	68.84	68.11	68.91	68.79	65.71	65.57	65.94	59.74
10000	65.29	65.71	65.97	65.38	65.76	64.93	64.79	64.06	64.35	57.62	65.83	65.47	66.25	65.22	65.57	65.47	64.49	64.6	63.99	57.62

Table A1.11 As measured sound pressure level data for the reference sound source, Laboratory 4, second determination

freq band	ISO 3744 microphone position (see Table 1)																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A-wt	83.9	84.1	84.2	83.9	84.1	83.7	83.9	83.6	83.5	82.8	84.4	84.0	84.5	83.8	84.2	84.1	83.7	83.7	83.7	82.8
50	72.48	71.8	72.15	71.42	72.01	71.54	73.61	71.28	68.79	66.32	73.52	71.54	72.15	71.33	71.94	71.99	68.86	69.75	69.61	66.32
63	70.98	70.77	71.02	70.55	70.88	70.86	70.11	69.07	68.34	65.57	72.41	71.05	71.47	70.91	70.81	70.81	68.32	68.95	70.01	65.57
80	72.18	72.2	72.11	71.64	71.78	71.59	69.71	69.43	69.07	64.96	72.15	72.04	72.62	72.06	71.92	71.99	69.03	69.14	68.67	64.96
100	71.12	70.81	71.05	70.53	71.05	70.39	68.67	68.44	68.16	63.69	71.38	70.86	71.73	70.51	70.91	70.53	68.2	68.55	68.51	63.69
125	70.86	70.34	70.88	69.97	70.25	69.78	68.3	68.04	67.76	63.43	70.98	70.25	71.19	70.11	70.48	70.44	67.94	68.32	67.68	63.43
160	70.51	70.86	70.46	69.54	70.46	70.04	68.04	67.9	68.04	63.92	71.28	70.25	71.78	70.22	69.73	70.34	68.13	68.18	67.83	63.92
200	70.62	71.07	70.91	69.28	70.04	69.99	67.45	67.1	67.17	63.66	70.65	70.37	71.4	70.27	69.97	70.13	67.38	67.47	67.26	63.66
250	71.26	70.67	70.72	69.43	70.27	69.97	67	67.05	66.98	64.44	71.21	70.86	71.14	69.82	69.97	69.87	67.17	67.31	66.49	64.44
315	70.88	71.4	71.21	69.9	70.11	69.1	66.09	66.41	66.3	65.05	71.17	70.95	71.21	69.57	69.47	69.9	65.83	65.87	65.92	65.05
400	71.49	71.78	71.57	69.31	69.05	69.4	65.57	65.17	65	65.73	71.68	71.73	71.96	69.57	69.31	69.05	65.45	65.52	65.73	65.73
500	72.06	72.15	72.41	68.6	69.35	68.65	65.94	65.85	65.66	67.54	72.34	71.92	72.53	68.93	68.88	68.91	65.76	65.83	66.09	67.54
630	72.95	72.79	72.88	67.78	67.85	67.76	68.81	68.53	67.83	71.17	72.95	72.62	73.16	67.85	67.47	67.52	68.41	68.46	68.93	71.17
800	74.03	74.01	74.22	66.6	66.41	66.11	72.34	72.01	71.24	73.63	74.27	74.13	74.43	66.3	66.67	66.27	71.94	72.11	72.44	73.63
1000	75.02	74.69	75.49	68.18	68.93	68.13	74.34	74.13	73.87	73.02	75.35	75.07	75.33	68.08	68.88	69.05	74.25	74.32	73.68	73.02
1250	75.66	75.77	75.8	74.74	75.23	74.41	74.29	73.71	73.89	77.04	76.17	75.87	76.08	74.58	75.66	75.59	73.78	74.03	73.68	77.04
1600	72.86	74.06	73.75	75.38	75.38	75.09	74.58	74.22	73.54	74.11	73.92	74.15	73.54	75.07	75.59	75.35	74.15	73.89	74.6	74.11
2000	68.04	69.61	69.31	74.11	73.8	73.73	76.46	75.99	76.03	70.55	69.61	69.66	69.1	73.94	73.71	73.45	76.27	76.06	76.2	70.55
2500	65.14	65.8	65.19	71.73	71.99	71.59	71.82	72.22	72.25	68.91	65.73	65.45	66.6	71.57	72.2	72.01	72.25	72.04	72.25	68.91
3150	71	70.32	69.75	74.34	74.65	74.41	69.07	69.71	69.21	67.9	71.38	70.32	72.72	74.22	75	74.95	69.24	69.1	69.61	67.9
4000	73.71	73.92	73.33	71.87	71.87	72.06	69.64	69.24	69.33	67.03	74.15	73.07	74.65	71.78	71.85	71.89	69.21	69.78	68.77	67.03
5000	71.87	73.02	73.19	71.92	72.29	71.57	70.65	69.35	69.66	63	72.62	72.04	72.53	71.99	72.04	72.2	69.73	70.39	68.86	63
6300	69.64	70.08	70.81	69.35	69.92	69.35	69.05	69.87	69.28	62.65	70.08	70.25	70.27	69.14	69.92	70.04	69.68	69.19	69.73	62.65
8000	67.59	67.47	67.71	68.2	68.86	68.2	66.46	65.62	65.83	59.64	67.97	66.93	68.88	68.06	68.86	68.79	65.71	65.62	65.9	59.64
10000	65.38	65.64	66.01	65.43	65.8	65.05	65.22	63.92	64.42	57.27	65.78	65.52	66.3	65.12	65.57	65.52	64.51	64.67	63.97	57.27

Table A1.12 As measured sound pressure level data for the reference sound source, Laboratory 4, third determination

freq band	ISO 3744 microphone positions (see Table 1)																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A-wt	83.9	84.2	84.1	83.9	84.2	83.6	83.9	83.6	83.5	82.8	84.4	84.0	84.5	83.8	84.3	84.1	83.7	83.7	83.7	82.8
50	73.02	72.15	71.92	71.61	71.61	71.49	70.88	69.54	69.12	63.38	72.72	72.18	74.46	71.26	72.46	71.59	68.98	69.66	69.43	63.38
63	71.59	71.71	71.12	71.92	71.52	70.69	68.84	70.91	68.3	62.25	71.4	71.05	71.54	71	70.86	70.93	68.74	69.71	70.41	62.25
80	72.46	72.76	72.18	71.33	72.39	70.93	69.5	69.17	68.81	61.41	71.96	71.64	72.84	71.92	71.89	72.04	68.77	69.38	68.63	61.41
100	70.77	71.38	71.19	70.55	70.48	70.22	68.53	68.37	68.01	61.29	71.28	70.86	71.33	70.6	70.79	70.88	68.18	68.86	68.44	61.29
125	71.07	70.34	70.69	70.08	70.48	70.18	67.85	67.87	67.9	61.95	71.07	70.39	71.33	70.08	70.22	70.53	68.04	68.18	67.66	61.95
160	70.32	71	70.27	69.71	70.48	70.15	67.47	67.94	67.97	63.4	71.09	70.37	71.47	70.39	69.94	70.15	68.16	68.25	67.87	63.4
200	70.88	71.21	70.79	69.12	70.22	70.01	67.4	67.17	67	62.82	70.74	70.18	71.21	70.32	69.85	69.94	67.45	67.43	67.24	62.82
250	71.19	71.07	70.81	69.45	70.18	69.9	67	66.89	66.91	64.39	71.42	70.91	71.33	69.9	69.87	70.08	67.21	67.19	66.86	64.39
315	71.02	71.49	71.21	69.92	69.94	69.31	65.97	66.44	66.18	64.91	71.38	70.69	71.49	69.71	69.59	69.87	65.78	66.04	65.8	64.91
400	71.75	71.82	71.52	69.31	69.14	69.35	65.52	65.47	65.19	65.66	71.8	71.61	71.68	69.4	69.43	69.21	65.54	65.45	65.87	65.66
500	72.11	72.15	72.2	68.77	69.28	68.67	65.9	65.71	65.54	67.36	72.36	71.8	72.41	69.03	68.88	68.93	65.87	65.8	66.25	67.36
630	72.88	72.81	72.84	67.73	67.99	67.68	68.72	68.6	67.97	71.14	73	72.55	73.02	67.78	67.59	67.68	68.39	68.48	68.77	71.14
800	74.08	73.94	74.2	66.7	66.53	66.04	72.29	71.99	71.21	73.68	74.18	74.15	74.34	66.3	66.81	66.27	71.89	72.11	72.46	73.68
1000	75	74.79	75.4	68.16	68.93	68.06	74.36	73.89	73.87	72.98	75.45	74.98	75.21	68.2	69.21	68.86	74.22	74.39	73.61	72.98
1250	75.59	75.77	75.8	74.72	75.21	74.32	74.34	73.66	74.03	77.07	76.25	75.8	76.06	74.67	75.85	75.42	73.87	74.06	73.63	77.07
1600	72.81	74.08	73.75	75.49	75.49	74.95	74.79	74.27	73.52	74.18	73.99	74.13	73.38	75.07	75.73	75.38	74.15	73.99	74.58	74.18
2000	68.08	69.64	69.35	74.18	73.92	73.63	76.39	76.03	76.1	70.62	69.64	69.75	68.72	74.03	73.75	73.4	76.27	76.1	76.13	70.62
2500	65.17	65.9	65.22	71.82	72.06	71.52	71.85	72.25	72.27	68.86	65.66	65.4	66.37	71.64	72.32	71.87	72.36	72.04	72.27	68.86
3150	71.05	70.39	69.78	74.34	74.74	74.29	69.07	69.71	69.28	67.97	71.35	70.3	72.67	74.29	75.12	74.81	69.28	69.17	69.73	67.97
4000	73.85	73.99	73.38	71.92	71.94	71.99	69.66	69.26	69.35	67.1	74.13	73.12	74.72	71.8	71.89	71.87	69.21	69.8	68.88	67.1
5000	71.96	73.09	73.14	71.99	72.32	71.49	70.65	69.38	69.75	63.05	72.67	71.99	72.51	71.99	72.11	72.2	69.75	70.37	68.86	63.05
6300	69.71	70.01	70.91	69.43	69.97	69.24	69.12	69.85	69.38	62.65	69.97	70.27	70.22	69.19	70.04	69.94	69.73	69.17	69.75	62.65
8000	67.61	67.52	67.73	68.23	68.84	68.11	66.46	65.62	65.9	59.64	67.97	66.93	68.86	68.08	69	68.72	65.76	65.62	65.97	59.64
10000	65.43	65.66	65.99	65.47	65.85	64.93	65.19	63.95	64.46	57.27	65.71	65.5	66.3	65.19	65.66	65.47	64.51	64.72	63.99	57.27

Table A1.13 As measured sound pressure level data for the generator, Laboratory 1, first determination

Freq band	ISO 3744 microphone positions (see Table 1)																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A-wt	84.76	86.73	86.45	87.16	87.46	88.31	88.55	87.63	88	87.39	86.69	86.73	87.04	88.26	88.03	86.76	87.63	88.12	87.42	87.7
50	84.17	87.09	91.63	91.72	87.28	85.89	90.54	84.57	84.62	86.52	86.26	92.26	87.84	86.19	91.11	83.87	85.75	85.72	90.43	86.73
63	71.05	72.79	76.88	76.83	73.02	71.73	75.89	70.6	70.53	72.04	72.13	77.59	73.49	71.78	76.27	70.15	71.4	71.31	75.8	72.06
80	83.14	76.36	84.1	83.51	75.4	82.27	83.51	80.43	72.88	79.28	83.37	82.76	74.34	74.62	83.61	82.64	75.16	80.27	84.15	79.35
100	71.82	70.46	74.83	71.92	70.53	73.45	74.27	73.16	73.38	73.82	73.09	74.22	70.25	70.91	73.47	71.64	70.37	74.06	71.61	74.06
125	76.81	83.44	83.54	79.3	81.98	80.1	77.07	78.6	80.15	75.96	80.57	81.4	81.8	81.56	80.57	76.13	80.71	79.11	78.55	74.5
160	73.4	81.65	79.58	77.59	78.74	77.07	68.91	68.11	77.84	73.73	77.07	79.56	78.08	78.9	78.69	73.73	76.17	75.33	72.44	74.41
200	75.16	84.66	78.34	72.36	80.53	77.02	71.99	71.05	71.94	73.45	79.82	74.32	82.08	81.09	74.32	74.62	68.67	70.53	72.04	73.71
250	79.18	79.89	75.38	73.26	74.5	69.31	72.25	70.62	74.5	74.88	71.33	73.87	81.09	74.22	74.34	74.62	69.19	74.5	72.44	75.23
315	73.49	73.05	73.23	69.82	69.9	65.66	70.46	68.6	68.25	72.11	74.06	74.83	74.83	66.96	66.74	68.18	69.21	70.53	68.32	72.79
400	69.94	71.92	72.39	67.26	70.25	66.7	70.15	71.05	72.84	71.61	75.45	70.25	72.39	68.77	66.65	64.93	70.48	73.12	70.44	72.84
500	75.85	75.07	75.38	71.94	70.65	74.22	72.2	75.21	73.75	73.99	73.8	75.14	73.56	71.19	73.05	70.62	74.34	71.87	73.66	74.06
630	76.65	79.37	77.8	82.27	79.58	81.61	81.94	80.08	78.6	81.7	77.75	79.18	76.93	82.2	83.14	80.64	76.74	80.13	78.79	82.55
800	76.27	77.7	79.18	78.13	79.68	79.42	84.62	78.93	81.65	81.47	80.15	76.65	77.63	81.8	80.27	81.02	80.53	80.06	82.76	81.65
1000	72.2	71.21	73.8	76.34	77.42	75	76.62	78.5	76.29	77.63	74.13	73.75	74.34	75.21	73.12	75.28	77.23	76.36	77.07	78.24
1250	69.26	71.61	72.58	72.32	72.95	75.68	74.74	74.32	75.49	76.1	71.19	72.62	70.34	74.06	75	72.98	73.49	75.63	72.32	75.77
1600	72.36	72.79	73.26	76.13	76.06	77.12	77.63	78.5	77.35	74.79	75.16	74.74	75.63	76.34	77.02	75	76.76	76.88	75.07	75.12
2000	75.73	74.62	76.27	75.07	75	79.8	77	78.69	77.28	77.23	77.63	76.36	76.34	77.96	79.54	77.07	77.56	80.57	77.09	76.76
2500	74.15	74.95	75.63	77.37	77.84	78.24	74.41	74.41	76.76	74.69	76.57	77.12	75.92	76.55	75.12	73.35	78.01	75.99	75.33	75.26
3150	72.32	76.79	75.23	74.69	74.36	75.45	74.22	73.66	75.8	71.31	72.95	75.21	76.2	74.62	74.79	74.11	74.62	74.74	73.82	72.15
4000	70.95	75.28	73.87	72.79	74.74	76.03	73.35	74.74	75.54	71.49	72.84	75.38	76.74	75.77	73.38	72.76	75.73	75.07	73.63	71.33
5000	67.61	73.45	70.11	71.68	73.26	70.22	70.39	69.97	72.32	69.66	69.57	71.49	73.05	73.45	70.72	70.01	72.53	71.21	70.77	69.66
6300	67.52	70.81	69.14	71.21	72.48	69.47	69.94	68.72	70.79	65.85	67.21	70.6	70.48	72.25	70.65	68.04	69.57	70.91	70.15	66.74
8000	67.07	71.42	70.6	70.39	72.76	70.04	69.12	68.72	71.26	66.46	69.82	70.91	73.02	72.15	69.97	68.91	70.88	70.67	70.01	65.9
10000	64.74	66.86	64.16	64.93	68.55	66.96	64.89	66.23	69.66	62.65	65.9	64.63	67.68	68.13	65.38	64.46	69.31	67.87	63.92	62.89

Table A1.14 As measured sound pressure level data for the generator, Laboratory 1, second determination

freq band	ISO 3744 microphone positions (see Table 1)																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A-wt	83.77	87.16	86.05	87.28	87.37	88.07	88.31	87.28	87.49	87.75	86.55	86.71	87.09	88.57	88.12	86.83	87.49	88.69	87.75	87.91
50	84.1	86.97	91.72	91.72	86.92	85.86	90.78	84.19	84.57	87.3	86.19	92.05	87.72	86.15	91.77	84.1	85.42	86.1	90.38	87.3
63	70.32	72.53	76.9	76.88	72.25	71.92	76.2	70.01	70.25	72.48	72.2	76.97	73.56	72.06	77.04	70.01	70.79	71.92	75.92	72.72
80	82.9	76.36	84.1	84.36	73.56	82.6	83.25	81.02	72.32	80.03	83.44	82.36	73.49	75.54	83.82	82.31	75.14	80.36	83.96	80.53
100	70.86	69.43	74.62	71.73	69.57	73.16	73.78	71.92	72.44	73.75	72.98	74.34	69.82	71.09	73.75	70.84	69.52	73.82	70.62	73.99
125	77.42	83.44	83.51	78.5	81.23	80.5	77.28	77.35	80.29	74.41	80.81	81.4	81.7	82.31	81.82	75.73	79.94	79.21	79.51	74.55
160	74.06	81.94	79.42	77.37	77.8	76.72	68.81	69.31	77.04	74.69	77.28	78.39	78.74	79.4	78.27	72.95	75.85	73.99	73.12	75
200	75.99	84.83	78.08	72.53	79.94	76.03	71.07	71.49	71.33	72.95	79.94	73.49	82.74	80.36	71.33	75.21	69.66	67.47	71.68	72.88
250	77.09	80.06	74.48	71.12	73.99	66.41	72.84	71.87	73.66	74.69	70.69	73.75	80.95	72.32	73.26	73.68	69.66	73.89	71.78	74.62
315	71.54	71.82	74.08	69.03	70.25	66.3	69.52	70.34	65.31	73.26	73.47	76.1	73.61	67.85	70.01	67.47	68.01	70.04	71.26	73.71
400	71.19	71.24	74.41	67.07	70.18	68.86	69.75	69.66	71.33	72.39	75.92	69.35	72.58	72.13	69.35	64.37	70.08	74.32	71.68	72.53
500	75.49	74.83	74.58	73.68	71.09	72.67	71.47	75.14	74.15	73.05	74.22	75.07	74.83	71.87	74.93	71.33	75.45	71.54	72.88	73.54
630	74.27	80.81	79.07	83.07	79.94	80.24	80.06	78.64	78.74	82.52	77.56	81.16	77.07	82.43	84.17	80.64	77.35	81.23	77.49	82.52
800	72.98	78.17	76.88	77.07	78.34	79.8	84.62	79.18	81.47	82.01	80.24	77.04	78.39	81.51	80.38	81.07	78.55	80.97	82.81	82.69
1000	71.33	71.68	73.61	75.99	76.39	74.69	76.57	77.63	75.26	78.15	74.27	73.73	74.62	76.17	73.33	75.45	76.86	76.29	77.8	78.24
1250	68.13	71.19	71.68	72.62	73.26	75.12	74.5	74.69	74.83	75.07	71.21	72.11	70.32	74.74	74.15	72.95	72.84	76.17	73.16	75
1600	72.25	73.85	73.35	75.33	76.36	76.79	77.94	78.01	76.17	76.06	74.41	74.13	75.73	77.04	77.35	73.99	77.44	75.89	76.5	75.54
2000	74.88	74.62	75.45	75.89	75	79.28	76.41	78.22	76.57	77	77.7	76.48	76.39	78.08	78.5	77.63	77.35	81.42	78.01	77
2500	72.72	75.07	74.95	77.84	78.15	79.04	74.5	74.62	76.25	73.66	75.68	76.03	75.85	77.42	74.34	74.55	77.96	76.79	75.89	73.99
3150	72.32	76.93	74.83	74.06	74.34	75.49	73.87	73.12	74.95	72.84	72.88	74.34	75.59	75.33	74.2	73.66	75.14	74.69	73.8	73.16
4000	71.21	75.96	73.54	72.58	75.38	75.59	73.73	74.58	74.69	71.78	72.44	74.83	76.5	75.49	73.02	72.53	76.25	76.06	74.06	72.11
5000	68.32	73.78	71.02	71.4	73.49	70.65	70.79	71.05	72.62	70.22	69.52	72.13	73.33	73.8	72.58	70.04	71.64	71.47	70.86	70.27
6300	67.45	70.53	69.19	71.57	72.53	69.19	70.11	68.25	70.65	67.64	67.14	69.87	70.32	72.48	71.21	68.18	70.67	70.91	69.61	66.74
8000	66.93	72.27	71.21	70.81	72.62	69.26	70.53	68.11	71.57	65.52	69.75	70.86	72.36	72.36	71.02	68.81	70.44	71.14	70.67	66.6
10000	63.64	66.09	64.23	64.89	68.91	66.41	64.86	65.8	69.57	62.79	66.18	64.46	67.33	68.67	65.38	64.06	69.75	68.53	63.99	62.75

Table A1.15 As measured sound pressure level data for the generator, Laboratory 1, third determination

freq band	ISO 3744 microphone position (see Table 1)																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A-wt	84.15	87.28	86.1	87.16	87.16	88.03	88.52	87.49	87.35	88	86.31	86.59	87.13	88.52	88.45	86.85	87.84	87.96	87.67	87.93
50	83.82	87.16	91.56	91.79	86.88	85.49	90.5	84.71	84.36	86.83	86.01	92.07	87.72	86.45	91.77	83.91	85.72	85.49	90.54	86.55
63	70.22	72.76	76.81	77.16	72.06	71.33	75.89	70.39	70.04	72.44	71.99	77.23	73.26	71.82	77.07	70.86	71.21	71.33	75.96	72.13
80	82.74	76.34	83.68	83.98	73.71	81.87	83.87	81.18	72.32	79.54	83.25	82.27	73.28	74.48	83.96	82.27	75.49	80.53	83.87	79.37
100	71.82	69.12	74.41	73.09	68.6	72.53	73.35	72.44	72.13	73.99	72.22	74.62	68.53	69.75	73.87	71.21	69.66	73.35	70.98	73.71
125	77.14	83.25	83.09	78.55	81.23	79.89	77.16	77.96	80.08	73.73	81.35	81.09	81.82	81.75	81.75	76.06	80.36	78.97	78.86	74.5
160	73.66	81.47	79.51	77.59	77.56	75.73	69.75	68.67	76.65	74.27	77.04	78.81	78.5	78.34	77.84	73.61	74.93	74.06	73.85	74.06
200	75.59	84.88	78.86	72.84	79.54	77.04	72.79	69.9	69.1	73.75	80.08	73.71	83.04	80.71	71.61	75	70.48	70.72	71.99	73.92
250	77.35	79.28	73.92	71.14	73.61	69.57	73.85	72.44	72.76	75.05	69.52	73.49	80.76	74.69	73.05	73.68	71.21	74.01	71.61	75.33
315	72.48	72.44	73.19	68.04	69.57	65.12	71.61	72.44	66.7	74.69	73.09	75.45	73.61	67.73	69.35	67.94	70.04	68.55	72.62	74.03
400	71	72.25	73.63	67.24	70.25	67.47	71	69.94	69.94	72.91	75.14	69.47	72.62	71.05	69.21	66.3	71.02	72.06	70.01	72.06
500	75.96	73.38	75.07	72.36	69.82	74.03	72.2	75.45	75	74.62	73.26	75.96	75.14	71.57	74.36	70.25	75.38	72.25	73.66	74.11
630	75.63	80.57	78.08	82.71	79.7	80.36	81.91	79.28	77.14	82.6	77.84	80.15	77.14	82.5	85.14	81.28	78.06	80.13	78.69	82.57
800	73.4	79.94	76.27	78.29	78.74	79.14	84.62	79.68	81.56	81.87	79.14	77.23	78.08	82.31	80.22	80.85	80.13	80.36	83.09	82.52
1000	70.91	72.48	73.28	75.73	77.12	74.55	77.52	78.86	75.38	79.11	73.71	73.35	73.78	76.41	73.66	75.45	77.8	76.5	77.28	77.94
1250	69.14	71.99	71.73	72.13	72.32	74.79	74.22	74.41	74.62	75.21	71.33	71.78	70.37	74.65	74.15	72.48	72.36	75.77	72.84	75.63
1600	72.39	73.87	73.45	75.54	76.03	77.14	77.63	77.89	75.85	75.33	75.14	73.38	75.77	76.27	77.7	74.62	77.44	74.83	75.45	75.96
2000	75.38	74.62	76.81	75.38	74.55	79.35	76.39	78.22	77.23	77.89	77.44	75.73	77.12	77.7	77.96	77.23	76.27	80.08	77.8	76.81
2500	73.38	74.62	74.65	77.16	77.35	78.97	74.06	73.96	75.73	75.28	75.21	76.34	75.33	76.5	75.45	74.36	77.89	76.36	75.68	74.43
3150	72.15	76.67	75.59	74.62	74.41	75.59	73.99	72.48	74.58	72.62	73.33	74.88	76.62	74.93	74.43	73.75	76.1	74.74	73.45	72.91
4000	70.86	76.76	73.92	72.72	75.14	75.59	73.63	75.07	74.95	71.54	72.91	75.63	76.27	76.17	73.61	72.88	76.88	75.38	73.71	72.06
5000	68.48	72.76	70.48	70.88	73.35	69.71	70.34	70.69	72.39	69.61	69.66	71.82	72.76	73.16	72.15	69.94	72.22	71.21	70.86	70.01
6300	67.36	70.91	69.75	71.57	72.2	69.47	69.87	68.08	70.08	67.14	67.1	69.9	70.53	72.67	71.4	67.78	70.81	70.55	69.94	67.83
8000	68.23	70.48	70.98	70.51	72.39	69.05	69.05	69.12	71.47	65.8	69.61	71.4	72.76	71.92	71.02	69.1	70.79	70.74	70.18	66.7
10000	63.8	66.04	64.77	65.12	68.32	66.51	64.77	65.38	68.98	63.4	66.3	64.46	67.5	68.18	65.66	63.92	69.47	67.71	63.64	63.76

Table A1.16 As measured sound pressure level data for the generator, Laboratory 2, first determination

freq band	ISO 3744 microphone positions (see Table 1)																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A-wt	83.9	86.3	85.7	86.4	87	88	87.9	87.2	87.4	86.6	88.4	86.7	87.2	88.4	88.1	86.5	87.4	87.7	86.9	86.5
50	87.9	88	89.2	87.8	87.4	88.2	88.2	87.6	87.9	87.4	88.8	88.5	87.9	87.7	88.6	87.8	87.8	88.1	87.7	87.4
63	75.2	75.5	77.5	74.9	74.6	75.5	75.4	74.6	75.4	74.5	76	76	75	75.1	75.7	74.9	75.2	75.7	75.1	74.7
80	80.4	78.6	85.2	83.8	76.6	79.2	82	79.4	76	78.8	80.6	85	77.9	77	83.9	79.8	76	78.9	82.3	78.5
100	68.1	72.1	75.6	71.6	69.7	70.8	72.8	69.5	72.8	73.5	71.5	73.8	70.8	71.4	73.2	66.2	70.7	72.5	70.3	74
125	82.2	83.8	82.8	81	80.1	80.2	78.7	78.4	78.8	75.3	82.5	83.2	83	81.4	81.1	80.3	78.1	78.3	78.9	75.5
160	76.6	82.2	78.9	77.2	78.1	75	73.7	72.7	73.9	70.6	77.5	79.8	81.3	79	75.9	74.5	73.4	72.9	74.8	70.3
200	75.7	82.6	75.4	67.8	78.4	76.8	67.6	61	69.6	73.3	79.9	71.1	81.5	80.1	71.6	72.4	66.7	68.8	63.6	73.5
250	75	78.6	74.4	72.1	77	70.5	73.9	69.9	71.2	76.1	73	76.3	81.7	73.6	72.5	72.6	68.3	73.8	70.8	75.9
315	69.4	74.4	71.7	65.1	71.9	65.4	69.5	71.4	64.4	73.9	71.6	71.4	74.4	67.8	67.3	68	68.9	67.5	71.6	73.7
400	70	74.4	74	65.6	67.1	65.9	69.3	69.5	70.3	72.9	78.1	69.5	71.5	68.5	64.5	63	71.2	73.7	67.2	72.7
500	74.4	72.4	74	72.1	70.8	73.3	71.3	71.1	73.6	72.7	73.6	73.9	72.8	71.4	73.2	70.8	70.7	71.9	71.8	72.6
630	73.2	78.9	77	81.3	79.3	79.9	79.9	77.9	76.6	81.1	73.7	78.7	73.4	80.9	83.7	79.4	76.6	79.3	76.6	81
800	74.6	75.8	75.5	76.9	78.6	80	83.7	79.5	82	81	84	76.9	78.5	80.7	80.5	80.6	79.2	79.9	82.2	80.9
1000	69.3	72.8	72.8	75	76	74.7	76.3	78.8	75.9	77.6	76	74.3	74.6	76.5	73.3	75.9	76.8	75.7	77.6	77.6
1250	69.2	68.1	70.3	72.1	72.3	74.8	72.8	73.8	74.3	73.2	70.4	71.9	68.7	73.9	73.2	72.7	71.8	74.2	71.9	73.3
1600	73.6	72	71.4	74.7	75.3	76	76.9	77.5	76.5	74.1	74.7	73.3	74.4	75.8	76.4	73.5	75	73.7	73.9	74
2000	77.1	75.9	76.4	74.3	73.9	79.4	77	78.5	76.7	76.3	78.5	76	77	79.3	78.5	77.3	77.4	81	77.2	76.1
2500	75.5	76.5	75.7	77.3	78.5	79.2	75.5	74.1	76.2	72.4	79.7	77.9	77.7	78.9	76.8	74.4	78.7	76	74.2	72.4
3150	72.7	75.3	74.8	73.7	74	75.5	73.9	73.2	75.3	71.5	74	75.4	76.8	75	75.3	73.6	75.8	74.2	72.5	71.3
4000	70.5	74.1	74.3	71.8	74	74.9	73.4	74.4	74.8	71.5	73	75.2	75.6	75.3	73.1	72.2	77.2	74.5	74	71.6
5000	69.2	71.7	71.1	71.8	73	70.9	70.3	70.7	71.5	67.5	70.4	72.3	73.4	73.7	72.9	70.5	71.3	70.9	70.7	67.3
6300	66	69.8	69	69.8	71.7	68.5	68.6	66.9	68.6	65	67.2	70.2	70.9	71.2	70.6	67.1	68.9	68.8	68.3	65.2
8000	69.9	70.7	72.1	70.3	72	71.1	67.9	66.3	69.2	62.2	73.5	71.8	72.7	72	71.2	71.1	69.8	72.3	69	62.4
10000	64.2	66.3	65.7	65.2	68.5	66.4	62.9	62.8	67.1	59.1	67.2	64.7	68	68.6	65.2	64.5	66.8	65.9	62.7	59.1

Table A1.17 As measured sound pressure level data for the generator, Laboratory 2, second determination

freq band	ISO 3744 microphone position (see Table 1)																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A-wt	83.9	85.9	85.2	86.3	87.3	88.2	87.7	87.2	87.2	86.9	86.6	86.1	87.1	88.5	88.2	86.4	87.2	87.5	86.8	86.9
50	87.7	87.8	89	88	87.9	88.6	88.1	87.8	87.6	87.5	88.5	88.4	87.6	88	88.9	87.7	87.8	87.9	87.6	87.6
63	74.8	75.1	76.3	75.3	75.2	76	75.3	75.1	74.8	74.7	75.9	76	74.8	75.2	76.2	74.6	74.8	75.1	74.8	75
80	79.7	77.9	84.8	83.9	77	79.6	81.8	79.1	76.1	78.4	80	84.6	77.6	77.3	84.1	79.7	76.2	78.8	82.1	78.4
100	68.1	70.6	74.8	73.2	68.3	70.2	72.5	70.9	71.3	73.7	68.9	74.7	67.3	70.1	74.3	68.4	70.9	71.8	71.2	73.9
125	80.6	83	81.8	81.3	80.6	80.7	78.5	78.4	78.6	75.7	81.5	82.3	81.4	81.6	81.2	80.1	77.9	78.1	78.8	75.8
160	75.2	81.3	77.5	77.1	78.5	75.2	73.4	72.4	73.7	70.3	76	78.8	80.2	79.5	76.4	74	72.6	72.9	74.2	70.3
200	76.1	83.6	76	68.1	78.4	77.1	66.9	62.3	69.3	73.6	79.9	72.3	81.8	80	71.5	72.7	66.3	68.5	63.8	73.8
250	75.8	79.4	74.5	71	78.5	71	74	71.1	69	75.3	72.6	76.1	82.5	73.3	72.5	71.8	68.6	73.5	72.2	75
315	70.7	74.4	72.5	64.5	71.7	65.6	71.2	72	65	74.1	70.6	72.3	75	67.7	67.7	67.9	70.4	68.7	73.1	73.8
400	68.7	73.3	72.8	65.8	68.1	66.8	70.2	71.8	71.1	73.3	76.9	69.3	71.2	68.4	64.7	62.9	73.1	72.4	69.9	72.9
500	73.9	73.3	74.9	72.3	71.6	74.2	71.1	72	73.4	72.3	73.7	74.8	70.9	72.3	73.7	70.5	71.2	72	72.4	72.4
630	74	76.9	76.5	81.4	79.8	80.5	80	77.8	76.4	81.3	75.7	78.3	74.9	81.6	83.8	79.6	77	78.9	77	81.4
800	73.6	75.8	74.8	77.3	77.7	79.9	83.5	79.7	81.8	81.5	80.4	75.4	75.7	80.3	79.5	80	79	79.7	82.7	81.5
1000	70	71	72.7	74.6	77.3	75	76	78.8	76	77.7	74.3	73.3	74.6	76.1	72.3	75.4	77.2	75.5	76.8	77.7
1250	68.5	68.7	69.3	71.8	72.8	75.3	73.3	73	74.2	73.7	70.3	72.2	69	74.2	72.9	73.2	72.4	74.4	71.5	73.8
1600	72	73.2	71.9	75.5	76.8	77.5	76.8	77.5	75.8	75.2	73.6	74	75.8	77.5	78.1	74.7	76.6	74.5	74	75.2
2000	75.4	75.4	75.1	74.4	75.6	80	76.6	78.8	77.1	76.6	77.4	75.5	77.4	79.8	79.6	77.2	76.1	80.7	76.6	76.7
2500	74.9	75.3	75.2	75.5	76.9	77.5	75.2	74.3	76.2	72.7	76.9	76.1	77.1	77.1	75.5	73.5	78.1	76	74	72.8
3150	71.8	75.2	74.4	74.5	74.4	75.6	73.8	72.9	74.9	71.3	73.6	74.8	76.5	75	75.4	73.4	75.7	73.9	71.8	71.2
4000	70.3	74.6	74.3	72	75.1	75.4	72.7	74.4	74.5	71.1	72.4	74.7	76.2	76	73.9	73	76.7	74.4	73.6	71.1
5000	68	72.4	70.6	70.9	73.9	70.9	69.8	70	71.5	66.9	69.7	72.1	73.2	72.8	72.5	70	70.9	71	70.3	66.9
6300	66.2	70.2	68.3	69.2	71.6	68.9	67.8	66.3	68.2	64.6	66.7	69.6	71	70.9	69.8	67.1	68.4	68.2	67.7	64.6
8000	68	70.5	69.7	69.5	70.9	68.3	67.2	66.1	68.9	62.1	70.6	70.9	72.9	71.9	70.3	68.2	68.7	69.9	68.5	62.1
10000	63.6	66.6	63.9	63.8	68.2	65.6	62.5	62.5	66.9	59	67.3	64.7	68.2	68.2	64.6	63.7	66.6	64.9	62.1	58.9

Table A1.18 As measured sound pressure level data for the generator, Laboratory 2, third determination

freq band	ISO 3744 microphone position (see Table 1)																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A-wt	83.9	86.4	85.2	86.3	87.2	88	87.8	87.1	87.4	86.6	86.6	86.2	87.3	88.1	88.1	86.3	87.1	87.7	86.8	86.6
50	87.8	87.9	89.1	88	87.9	88.6	88.2	87.7	87.7	87.6	88.8	88.3	87.8	87.8	88.9	87.8	87.8	88.1	87.7	87.6
63	75.3	75.2	76.3	75.4	75.2	76.1	75.5	75	74.8	74.8	75.9	75.3	75.1	74.9	75.8	75	75	75.2	74.8	75
80	79.8	78.1	84.7	83.7	76.9	79.6	82	79.1	76	78.5	80.1	84.4	77.9	77.3	84.2	79.6	76.2	78.7	82.3	78.6
100	67.6	71	75	72.5	69.5	71.2	73	70.7	72.4	74	70.6	73.3	68.9	71.3	74	67.4	71.5	72.9	71.2	74.1
125	80.7	83.1	81.7	81.2	80.8	80.7	78.5	78.2	78.5	75.7	81.6	82	81.5	81.5	81.1	80.1	78.1	78.3	79	75.8
160	74.8	81.8	77.8	76.8	78.2	75.7	73.8	72	74.5	70.4	76.6	79	79.9	79.8	76.6	74.2	73	73	74.1	70.4
200	76.4	83.4	75.7	68.7	78.5	77.1	67.7	61.9	69.7	73.7	80	72.3	82.3	80.1	71.3	72.7	66.4	69.5	64.4	73.9
250	77.8	80.3	75.9	70.7	79.2	69.8	71.9	68.2	71	76.3	74.7	77.4	83.4	74.7	73.3	73	65.4	74.7	69.5	76.1
315	72.6	73.8	72.9	65.2	71	65.9	71.3	70.2	66.5	73.5	72.7	71.6	75.9	67.4	66.4	68.7	67.1	70.4	71	73.4
400	69.6	74.2	72.3	66.3	68	68.1	69.4	71.3	70.9	71.9	76.6	68.6	71.8	69	66.7	62.9	72.2	72.7	69.2	71.8
500	74.4	73.6	74.3	72.3	72.5	73.8	69.9	72.8	74	72.2	74.2	75.2	71.7	71.4	72.7	70	71.9	71.8	72.9	72.1
630	74.9	77.9	76.1	81.3	80.1	80.5	80.5	77.7	76.8	81.3	75.7	78.5	75.5	81.3	83.8	79.5	76.2	79.4	77	81.3
800	71.8	75.3	74.7	76.9	78.3	79.8	83.7	78.6	81.8	80.9	80.2	75.7	77	80.1	80.3	80	78.9	79.3	82.5	80.9
1000	69	70.9	72.8	74.5	76.7	74.3	76.1	78.8	75.8	76.9	74.6	72.9	73.9	75.2	72.5	75.6	76.4	75.7	76.7	77
1250	68.8	69	69.6	71.6	72.6	74.8	73.3	74.1	73.9	74.1	70.3	72	68.7	73.4	73	72.6	71.6	74.6	71.2	74
1600	72.9	73.7	71.7	75.5	76.5	77.5	76.5	78.2	76.2	74.3	74.8	74.2	75.9	77.3	77.6	75.2	75.4	74.6	73.9	74.4
2000	75.2	75.8	75.1	75	75.7	79.9	76.9	78.4	77.2	76.1	77.1	75.6	77.4	79.4	78.9	77	77.1	81	76.8	76.2
2500	74.8	76	75.6	75.9	76.9	77.2	75.2	73.8	76.5	72.6	76.8	76.5	77.3	76	75.6	72.4	78.6	76.5	74.4	72.7
3150	71.4	75.8	74.7	74.3	74.1	75.3	73.7	72.9	74.9	71.1	73.5	74.4	76.4	75	74.9	73.4	75.4	74	72.1	71
4000	70.2	75.6	74	72.5	74.8	75.4	72.9	74.3	74.3	71.4	72.5	75.1	76.7	75.6	73.3	72.2	76.4	74.3	73.4	71.3
5000	67.6	73.2	70.8	71.2	73.5	70.9	69.7	70.2	71.3	67.3	69.7	72.4	72.8	72.5	71.6	69.2	70.9	70.6	69.9	67.3
6300	66.4	70.9	68.5	69.7	71.5	68.8	67.9	66.6	68.1	64.6	66.7	69.4	70.1	70.6	70	66.6	68.5	68.5	67.8	64.6
8000	67.4	70.5	70.7	69.5	71.4	68.6	67.1	66.7	69	62.3	70.7	71	72.3	71.9	70.5	68.8	68.8	69.2	68.4	62.3
10000	63.1	67.3	65.1	63.9	68.5	65.9	62.6	63.5	67.2	58.8	66.8	64.6	68.4	68.2	65.1	64.4	66.8	65.8	61.9	58.9

Table A1.19 As measured sound pressure level data for the generator, Laboratory 3, first determination

freq band	ISO 3744 microphone positions (see Table 1)																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A-wt	84.1	86.8	85.9	87.1	87.7	89	87.9	87.9	88.4	88	87.1	86.9	87.2	88.8	88.5	86.9	87.9	88.5	88.3	88
50	89	87.8	89.9	89.4	87.6	89.7	89.2	89.1	88.2	89	89.9	89.2	87.4	87.8	89.7	89.1	88.4	89.6	89.3	89
63	79.1	78	79.9	79.2	77.4	79.7	79	78.9	78	78.8	79.6	79.2	77.5	77.8	79.5	78.6	78	79.1	79.1	78.9
80	80.4	79.5	85.1	84.6	77.3	79.8	82.7	79.8	76.6	79.8	80.4	84.6	77.8	78.2	84.2	80.8	76.1	79.3	82.6	79.2
100	73	70.4	77.6	74.9	70.4	72.3	73.3	72.8	72.4	74.9	72.9	76.6	69.3	70.5	76.2	71.8	71.9	73.6	73.9	74.8
125	82.1	82.7	83	82.7	82.5	80.5	80.4	78.7	80.7	76	82	83.5	82.7	82.2	81.9	80.9	80.4	77.6	80.4	75.9
160	78	83.9	79.9	79.6	80.1	78.2	75.3	74.7	76.4	72.3	78.6	80.5	82	82	79	77.3	74.7	74.7	73.9	71.9
200	79	83.8	77.2	72.6	79.9	78.2	66.2	65	72.5	74.5	80.9	76	82.8	81	72.9	75.6	70	68	67.1	74.3
250	77	79.1	75.9	72.8	77.4	70.8	73.8	71.7	69.8	74.2	73.2	75.9	82.2	73.5	73.6	74.8	67.9	74.6	72.7	74.3
315	72.1	74.8	72.3	67.2	71.1	67.1	73.6	73.2	70.8	74.1	72.9	72.7	74.8	67.8	69.5	69.2	71.6	73.1	74.4	74.3
400	71.9	74.7	74.2	69.4	71.1	69.5	71.1	72.5	73.4	72.8	77.2	71	72	72.8	68.1	65.3	74.8	75.6	71.2	72.3
500	75.4	74.7	75.8	73.9	72.3	75.4	73.5	74.7	74.8	73.2	75.3	75	72.3	72.2	75.1	72	74.1	74.1	71.6	73.6
630	74.8	77.2	76.9	82.3	78.8	80.9	80.1	79.8	78.1	82.8	77.8	78.9	75.7	82.1	84.4	80.5	79	80.8	79.6	83.1
800	73.4	76.9	74.7	77.9	79.6	80.2	83.2	79.6	81.4	82.1	80.6	77.3	77.4	81.3	81.8	81	79.1	81.6	83.3	82.2
1000	69.5	71	73.9	76.1	78.2	75.6	76.5	78.4	76.5	78.5	75.5	74.4	74.9	77	75.1	76.1	77.5	76.7	76.1	78.6
1250	69.6	70.3	71	73.2	73.2	75.8	72.6	75.1	76.1	75.4	71.5	73.1	69.8	75	73.8	72.2	74	76	75	75.1
1600	72.9	74.3	74	77.1	77.5	78.6	76.2	79.2	79	76.5	75.9	74.3	75.5	78.7	78.2	75.9	77.5	75.7	80.3	76.1
2000	74.5	76.4	75.5	75.5	75.5	81.1	76.9	78.1	78.2	76.8	77	77	77.4	78.5	77.8	77.4	75.8	80.2	76.6	77.3
2500	74.1	75.7	74.8	76	77.5	79.7	77.2	74.7	77.4	74.3	76.3	77.3	76.5	77.8	75.9	74.7	78.1	77.9	75.7	74.6
3150	72.9	76.3	75.4	74.3	75.1	76.9	73.7	74.1	76.5	73	74.9	75.9	77	75.7	75.5	73.2	77.2	75	74.6	73
4000	70.9	76.6	75	73.9	75.5	76.2	74.2	74.8	75.6	72.8	74.4	75.3	76.5	76.6	73.8	73.2	76.9	75.5	73.7	72.6
5000	70	73.9	72.5	72.3	74.3	71.8	72.4	71.6	73.8	70.2	70.6	72.7	74	74.6	72.7	70.1	73.4	72.6	71.4	70.4
6300	67.5	72.1	69.7	71.1	72.9	70	71.5	69.2	71.5	69.2	68.2	71.1	71.6	73.3	71.7	68.7	72	71.2	70.6	69.2
8000	69.6	72.3	71.8	72.1	72.8	71.2	71.3	70.6	72.5	69.6	71.9	73	72.9	73.3	71.7	69.8	71.9	71.8	71.3	69.2
10000	65.5	68.8	66.2	67	69.6	68	65.9	67.1	71.3	65.2	67.5	67	68.7	69.9	66.3	65.6	70.3	69.5	66.9	65.5

Table A1.20 As measured sound pressure level data for the generator, Laboratory 3, second determination

freq band	ISO 3744 microphone position (see Table 1)																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A-wt	84.4	87	86.2	87	88	88.9	87.8	87.8	88.6	87.9	87.3	86.8	87.4	88.7	88.5	86.8	87.9	88.4	88	88.2
50	89.1	88	90	89.4	87.6	89.6	89.3	89.2	88.2	88.9	89.9	89.4	87.6	87.8	89.7	89	88.3	89.5	89.1	89
63	79.1	78	79.8	79	77.5	79.6	79.2	79.1	78.2	78.8	79.4	79.3	77.8	77.7	79.8	79.3	78.1	79.2	79.3	78.7
80	80.8	79.3	85.3	84.3	77.4	79.8	82.8	79.7	76.4	79.6	80.8	84.8	78.2	78.3	84.2	80.5	75.7	79.9	83	79.2
100	72.5	70.1	77.3	74.3	70.3	71.9	73.2	72.9	72.4	74.8	72.8	76.3	69.4	70.5	76.2	71.4	71.7	73.8	74	74.7
125	82.3	83.2	82.6	82.7	82.4	80.8	80.3	78.6	80.7	76	81.5	83.1	82.5	82.2	82.6	80.8	80.1	77.4	80.5	75.8
160	78.3	84	80.3	79.6	80.7	77.8	75.2	74.6	75.9	72.2	78.7	80.9	82.6	81.7	79.1	77.3	74	74.2	74.1	71.9
200	79	84.4	76.5	72.4	79.6	79	66.7	65.6	72.4	74.4	81	75.4	82.8	81.3	73.2	76.2	72.4	70.8	67	74.1
250	76.9	79.5	75.4	72.5	79.1	71.4	75	73.2	70.3	73.8	72.1	75.6	82.5	72.4	74.2	73.4	69.9	74.1	72.4	74.6
315	71.5	74.9	73.1	67.7	71.5	67.3	74	73.1	72.2	74.1	72.9	73.1	75.1	67.5	68.8	69.3	71.1	73	74	74.6
400	71.5	74.1	74.1	69.5	70.6	68.9	71.6	72.7	73.9	72.6	77.2	70.9	72.5	72.5	68.4	65.4	74	75.6	70.1	72.7
500	75.6	74.5	76	73.4	72.3	75.2	73.6	75	75.1	73.3	75.1	74.9	72	72.3	74.4	73.1	73.8	73.7	71.1	73.8
630	75.2	78.1	78.2	82.2	79.7	80.8	79.8	80.2	78.7	82.9	77.6	78.8	75.5	81.4	84.2	80.4	79	80.7	79.1	83.2
800	73.4	77.3	76.7	77.8	79.5	80.5	83.1	79.6	82	82	80.8	76.8	77	80.7	81.7	80.9	79	81.5	83.2	82.5
1000	69.6	70.9	74.4	75.8	78.1	75	76.4	78	76	78.4	75.6	74.7	74.6	76.9	74.4	76.1	77.6	76.3	76.3	78.8
1250	70.1	70.4	70.4	73.3	73.3	75.5	72.8	75	75.7	75.4	71.5	73.4	70.3	74.8	74	71.9	74	75.9	74.9	75.3
1600	73.1	74.5	73.9	76.9	77.9	78.3	76.2	79.3	79	76.5	75.9	74.3	75.2	78.5	78.5	75.6	77.3	75.3	79.5	76.2
2000	75.5	76.6	75.4	74.9	76.3	80.9	76.8	77.9	78.3	76.9	77.7	76.8	77.8	78.3	78.5	77.2	76.2	80.1	76.5	77.5
2500	75.1	75.9	75.5	76.2	78.1	79.6	77.1	74.6	77.6	74.4	76.3	76.9	76.8	78.1	75.9	74.5	78.1	77.9	75.5	74.6
3150	73	76.6	75.5	74.6	75	76.9	74.1	74	76.3	73	75	75.9	77.2	76.1	75.6	73.5	77.2	75.3	74.2	73.1
4000	70.6	76.4	74.8	73.7	76.1	76.4	74.3	74.4	75.6	72.9	74.8	75.1	76.8	76.7	74.1	73.2	77	75.7	73.7	72.7
5000	69.6	74	72.1	71.6	74.3	71.2	72.2	71.4	73.8	70.1	70.9	72.7	74.2	74.4	72.6	70.2	73	72.8	71.3	70.3
6300	67.5	72	69.4	70.9	72.7	69.4	71.4	69.2	71.5	69.1	68.8	70.9	71.9	72.7	71.2	68.1	71.5	71.1	70.2	69.3
8000	69.6	72.7	72.4	71	72.4	70.5	71.1	70.6	72.7	69.3	71.8	72.6	73.3	73.2	71.7	69.4	71.7	71.6	70	69.1
10000	65.3	68.6	65.7	66.2	69	67.2	65.7	66.8	71.3	65.2	67.5	66.8	69.1	69.5	66	65.1	70.6	69.1	66.3	65.5

Table A1.21 As measured sound pressure level data for the generator, Laboratory 3, third determination

freq band	ISO 3744 microphone positions (see Table 1)																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A-wt	84.3	87	86.1	87	87.9	88.8	87.8	87.8	88.5	88	87.1	86.9	87.5	88.6	88.6	86.8	87.8	88.3	88	88.1
50	89.1	87.9	90.1	89.3	87.6	89.6	89.4	89.2	88.1	89	89.8	89.4	87.5	87.7	89.8	89	88.3	89.5	89.2	89
63	79	77.8	80	79.3	77.3	79.2	79	78.9	77.9	78.7	79.7	79.2	77	77.6	79.7	78.9	78.3	79.5	79.1	78.8
80	80.7	79.2	85.5	84.2	77.4	80.3	83.2	79.7	76.5	79.5	80.4	84.6	77.8	78.3	84.3	80.2	75.8	79.9	83	79.3
100	72.7	70.7	77.1	74.3	70.3	72	73.4	72.8	72.5	74.7	72.6	76.1	70.2	70.7	76.1	71.1	71.8	73.7	74	74.8
125	82.3	83.2	82.7	82.7	82.2	80.9	80.2	78.5	80.5	75.9	82.2	83.9	82.9	82.1	82.5	80.4	80.2	77.5	80.5	75.9
160	78	83.5	80.6	79.6	80.6	78.1	75	74.8	76	72.2	78.3	80.7	81.3	82	79.3	76.9	74.3	74.4	74.1	71.8
200	79.3	84.3	76.8	73.6	80.1	77.9	66.3	65	73.6	74.2	81	75.6	83.3	81.4	73	75.8	71.2	70.5	67.1	74.2
250	76.9	78.9	75.7	71.2	79.1	71	74.7	72.4	69.9	74	72.1	76	82	73	73.9	74.3	68.5	73.6	72.6	74.4
315	71.9	74.8	73	67.8	71.6	67.1	74	73.7	70.6	74.3	72.4	73.8	74.8	67.7	68.8	68.6	71.7	73.1	74.1	74.5
400	71.3	74.1	74	69.3	70.5	69.7	71.7	72.8	73.7	72.6	76.8	71.1	72.4	72.1	70	64.4	74.4	75.6	70.6	72.7
500	75.6	74.7	76.7	73.1	72.8	74.7	73.5	75.1	74.4	73.3	75.3	75.4	73.1	71.8	74.5	72	74.2	73.6	71.2	73.6
630	75.4	78	78.1	82.3	79.4	80.8	79.7	80	78.5	82.9	77.2	78.8	76.3	81.3	84.4	80.3	78.9	81	78.9	83.1
800	73.6	77.5	76.5	78.2	79.6	80.3	83.2	79.2	81.8	82.2	80.5	77	77.7	81.2	81.9	80.9	78.6	81.3	83.3	82.4
1000	70.2	71.2	74.1	75.9	77.9	75.3	76.6	78.6	75.8	78.4	75.5	74.3	74.9	77.1	74.6	75.9	77.5	76.4	76.3	78.7
1250	70	70.3	71.4	72.9	73.5	75.7	73	75.3	75.7	75.4	71.1	73.2	69.9	74.4	74.4	71.6	74	75.9	74.9	75
1600	72.9	74.3	73.6	76.8	77.7	78.3	75.5	79.1	79.1	76.3	75.1	74.4	75.1	78	78.5	75.2	77	75.1	79.5	76.3
2000	75	76.6	75.6	74.8	75.8	80.2	76.9	77.9	78.4	77.3	77.7	76.9	77.7	78.5	78.2	77.6	75.6	80.1	76.4	77.5
2500	74.5	75.9	75.1	76.4	77.6	79.8	77.3	74.4	77.4	74.3	76.4	77.1	77.2	77.9	76	74.9	77.9	77.6	75.4	74.6
3150	73	76.6	75.3	74.7	75.3	76.5	74	73.9	76.3	73	74.8	75.9	77.3	75.8	75.5	73.5	77.3	75.1	74.1	73.1
4000	70.8	76.2	74.9	73.6	76.1	76.2	74.2	74.6	75.8	72.7	74	75.3	76.9	76.3	74	73.5	77.1	75.7	73.8	72.8
5000	69.1	74	71.9	71.7	74.7	71.6	72.4	71.6	73.8	69.9	71	72.7	73.7	74.7	72.6	70.3	73	72.7	71.4	70.3
6300	67.5	72.1	69.3	70.5	72.4	69.5	71.5	68.9	71.5	69	68.3	71	71.7	73.2	71.7	68.3	71.9	71.2	70.1	69.2
8000	69.4	72.5	72.2	70.7	72.2	70.9	71.1	70.7	72.8	69.3	70.9	72.9	72.7	73.2	71.8	70	72.1	71.4	70	69.3
10000	65.3	68.4	65.8	65.9	69	67.8	65.7	67.1	71.3	65.2	67.9	66.8	68.6	69.7	66.5	65.3	70.8	69.4	66.3	65.6

Table A1.22 As measured sound pressure level data for the generator, Laboratory 4, first determination

freq band	ISO 3744 microphone position (see Table 1)																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A-wt	83.6	87	85.2	86.4	86.6	87.9	87.8	86.4	87	86.1	85.9	86.2	85.7	88.2	87.6	86.3	86.2	87.5	87	86.1
50	87.96	87.25	88.8	89.84	86.92	86.8	88.33	88.38	86.45	87.32	87.2	90.12	86.69	86.8	88.66	88.38	87.04	86.55	89.46	87.32
63	73.56	73.38	74.95	76.25	72.81	72.91	73.87	74.86	72.22	74.11	73.52	76.36	72.62	74.25	74.86	75.38	72.98	72.27	75.54	74.11
80	79.77	78.24	84.66	85.56	78.08	81.28	80.71	80.27	74.5	76.03	81.7	86.95	77.84	77.54	83.35	80.1	77.73	78.5	83.35	76.03
100	67.31	71.87	73.99	73.09	71.17	70.27	70.84	70.95	72.15	73.73	65.03	75.12	68.37	74.32	72.72	68.93	70.25	71.33	72.39	73.73
125	81.7	82.5	81.51	81.56	80.31	80.85	77.12	78.34	79.35	75.38	81.16	83.25	81.07	81.09	80.36	80.43	77.59	76.95	77.4	75.38
160	77.59	81.61	79.11	77.37	77.89	74.34	72.2	73.35	73.66	66.16	75.8	80.45	79.07	79	75	75	73.23	71.12	73.85	66.16
200	75.56	83.28	76.62	68.55	77.3	76.5	67.19	63.78	68.63	72.44	79.87	74.06	80.34	79.56	68.46	73.45	67.31	67.54	67.1	72.44
250	70.88	78.74	71.87	68.11	75.05	68.84	73.8	70.25	66.7	70.53	71	75.09	77.63	74.11	73.75	68.32	68.95	70.01	70.88	70.53
315	72.36	71.94	73.66	69.85	66.7	68.6	71.92	75.54	72.72	78.76	72.91	77.07	72.08	69.19	69.19	64.16	74.43	71.31	75.56	78.76
400	71.21	73.09	73.96	67.31	68.06	67.14	69.82	72.95	70.01	72.48	74.08	73.45	72.98	70.34	66.7	65.1	70.3	73.49	72.18	72.48
500	73.45	74.6	74.36	73.16	71.24	73.63	70.91	71.71	73.94	72.67	74.32	75.49	72.25	71.57	73.47	72.11	71.21	72.34	73.71	72.67
630	77	78.1	78.01	81.68	79.09	81.35	80.01	78.15	78.67	81.91	77.04	78.46	75.07	81.33	83.32	80.17	77.49	80.71	78.36	81.91
800	76.1	77.12	76.62	76.62	77.89	79.33	84.31	78.9	81.94	79.94	80.97	76.86	76.01	81.4	79.82	79.98	79.91	82.55	83.11	79.94
1000	73.35	73.16	73.09	75.09	77.04	74.2	76.72	79.58	75.63	76.81	75.47	74.69	77.04	75.3	72.95	75.4	76.67	76.62	76.22	76.81
1250	69.28	71.57	72.32	72.88	72.88	74.06	75.02	74.9	75.38	73.56	71.45	72.2	71.31	73.87	74.03	72.79	72.69	76.79	74.69	73.56
1600	69.45	73.61	71.19	74.83	75.12	76.03	79.16	76.17	76.6	75.09	73.33	73.96	72.13	75.68	76.55	74.29	76.25	76.5	75.52	75.09
2000	69.47	71.85	70.77	77.12	75.63	80.45	73.33	75.28	74.74	73.59	71.85	73.99	70.98	79.77	79.07	77.4	73.23	75.28	76.22	73.59
2500	72.76	71.14	70.55	74.06	75.99	77.47	69.35	69.12	71.82	70.91	71.12	75.02	75.49	76.25	74.62	73.35	71.57	70.91	70.55	70.91
3150	71.99	79.21	75.68	73.66	74.25	75.33	72.53	71.92	74.48	70.34	74.11	76.65	75.16	74.9	73.26	72.95	73.87	72.44	71.75	70.34
4000	70.37	78.9	75.54	72.53	74.43	74.48	73.45	73.73	74.88	67.5	74.41	73.4	75.16	75.92	73.52	72.51	75.59	74.5	72.67	67.5
5000	67.07	69.87	67.97	69.43	71.87	69.21	69.5	69.82	71.52	65.73	67.9	68.58	71.92	71.33	69.47	68.34	72.2	70.84	70.67	65.73
6300	66.49	70.88	67.9	70.15	71.89	69.28	66.01	65.47	67.33	62.91	66.63	69.82	69.61	72.18	69.82	68.06	67.12	66.2	66.13	62.91
8000	69.38	71.94	70.81	70.39	70.98	68.37	69.12	68.81	69.75	63.15	70.55	69.59	71.92	71.64	69.12	67.28	70.3	71.35	68.81	63.15
10000	64.65	67.24	66.01	64.53	68.32	65.07	62.23	61.85	65.92	57.55	65.1	65.22	68.41	67.76	64.42	62.79	66.65	64.67	61.95	57.55

Table A1.23 As measured sound pressure level data for the generator, Laboratory 4, second determination

freq band	Iso 3744 microphone position (see Table 1)																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A-wt	83.5	87	85	86.7	86.7	88	87.9	86.4	87	86.2	85.8	86.3	85.7	88.2	87.6	86.3	86.2	87.4	87	86.2
50	88	87.23	88.8	89.82	87.16	86.88	88.4	88.4	86.45	87.35	87.25	90.1	86.71	86.8	88.64	88.17	87.11	86.73	89.37	87.35
63	73.8	72.95	74.72	76.17	73.47	72.76	73.78	74.34	72.48	73.99	72.86	75.8	72.39	73.82	75.47	73.8	73.09	72.69	74.95	73.99
80	79.89	78.17	84.59	85.51	78.46	81.47	80.67	79.89	74.58	76.81	81.61	86.85	77.8	77.37	83.68	79.7	77.73	78.62	83.51	76.81
100	67	71.89	73.85	73.33	71.4	70.67	70.88	70.72	72.13	73.75	65.26	74.93	68.25	74.32	73.05	66.98	71.07	71.61	72.29	73.75
125	81.7	82.48	81.4	81.56	80.48	81.04	77.3	78.27	79.4	75.85	81.11	83.07	80.83	81.09	80.53	80.38	77.91	76.9	77.33	75.85
160	77.47	81.65	79.11	77.23	77.66	74.46	72.34	73.54	73.78	66.81	75.21	80.36	79.4	79	74.6	75.16	73.38	71.09	74.13	66.81
200	75.87	83.28	76.81	68.93	77.63	76.27	66.91	64.13	68.51	72.62	79.49	73.68	80.31	79.51	67.54	72.95	66.49	67.94	67.45	72.62
250	70.86	78.71	71.92	67.94	75.42	68.48	73.47	70.39	66.39	69.9	70.79	75.23	77.75	74.13	73.38	68.01	68.53	70.27	70.79	69.9
315	72.95	71.94	73.38	69.66	67.36	67.92	72.32	75.28	72.69	78.6	73.35	77.19	72.13	69.26	68.44	63.92	74.9	71.64	75.68	78.6
400	71.49	72.72	73.42	67.45	67.68	67.43	70.27	73.05	69.82	72.58	74.62	73.16	73.21	70.39	65.03	64.6	71.38	73.38	72.81	72.58
500	73.54	74.39	74.62	73.38	71.14	73.52	71.54	71.92	74.01	72.04	74.39	75.99	72.01	71.61	73.78	72.48	70.95	72.13	74.06	72.04
630	77.07	78.03	77.82	81.96	79.3	81.11	80.03	78.27	78.69	81.47	76.69	78.81	75.07	81.33	83.3	80.31	78.34	80.62	78.46	81.47
800	75.92	77.23	76.53	76.67	78.1	79.58	84.26	78.67	82.1	80.57	80.57	76.41	75.82	81.47	79.44	80.01	79.51	82.41	83.11	80.57
1000	73.26	72.93	73.19	75.63	77.04	73.94	76.95	79.66	75.19	77.44	75.28	74.83	77.02	75.28	72.93	75.21	76.86	76.79	76.41	77.44
1250	69.03	71.75	71.94	73.02	73.09	74.03	75.23	74.93	74.95	72.95	71.49	72.44	71.17	73.85	74.01	72.32	72.51	76.62	74.15	72.95
1600	69.12	73.59	70.74	75.21	75.26	76.39	79	76.2	76.69	75.33	73.49	73.82	72.2	75.63	76.69	74.5	75.89	76.15	75.61	75.33
2000	69.54	71.78	70.77	77.33	75.99	80.43	73.23	75.14	74.88	73.49	71.8	74.06	71.21	79.7	79.28	77.56	72.48	75.4	75.61	73.49
2500	72.72	70.95	70.46	74.06	75.87	77.8	69.52	69.28	71.87	71.12	70.79	74.83	75.47	76.25	74.72	72.84	71.35	70.93	70.27	71.12
3150	71.94	79.4	75.59	73.85	74.2	75.49	72.62	71.82	74.22	70.69	74.18	76.97	75.21	74.79	73.47	72.98	73.99	72.44	71.8	70.69
4000	70.22	79	75.45	72.93	74.46	74.76	73.73	73.49	74.53	67.83	74.55	73.85	75.12	75.85	73.71	72.32	75.68	74.6	73.07	67.83
5000	66.91	69.9	67.87	69.71	71.78	69.24	69.64	69.73	71.71	65.64	67.71	68.79	72.04	71.35	69.35	68.39	72.13	70.84	70.6	65.64
6300	66.46	70.74	67.68	70.69	71.82	69.28	66.01	65.38	67.07	63.08	66.58	70.01	69.43	72.22	69.59	68.01	67.07	66.25	66.32	63.08
8000	68.79	72.15	70.55	70.91	71.24	68.7	68.88	68.51	69.99	63.29	71.26	69.94	72.22	71.71	69.33	67.26	70.2	71.21	68.6	63.29
10000	63.87	67.45	66.06	65.92	68.48	65.24	61.88	61.48	65.87	57.17	65.43	65.52	68.41	67.78	64.86	62.89	66.41	64.79	61.99	57.17

Table A1.24 As measured sound pressure level data for the generator, Laboratory 4, third determination

freq band	ISO 3744 microphone position (see Table 1)																			
A-wt	83.6	86.9	85.1	86.5	86.7	87.9	87.9	86.4	87	86.5	85.8	86.2	85.8	88	87.7	86.3	86.2	87.4	87.1	86.5
50	87.96	87.11	88.76	89.89	86.97	86.78	88.43	88.31	86.45	87.42	87.2	90.24	86.66	86.78	88.59	88.17	87.02	86.71	89.27	87.42
63	73.61	72.84	74.29	76.13	73.87	72.86	74.06	74.34	74.03	72.72	73.21	76.34	72.48	72.81	74.69	73.99	72.72	72.91	74.79	72.72
80	79.8	78.15	84.76	85.46	78.46	81.4	80.6	79.84	74.41	76.01	81.57	86.26	78.34	76.72	83.49	79.82	77.59	78.5	83.61	76.01
100	67.24	71.45	73.71	73.45	71.38	70.2	70.93	70.72	72.25	73.33	65	75.33	68.2	74.15	72.13	67.59	70.51	71.4	72.22	73.33
125	81.49	82.88	81.3	81.51	80.34	81.11	77.3	78.03	79.49	76.27	81.25	83.39	81	81.28	80.34	80.45	77.82	76.74	77.21	76.27
160	77.42	81.65	79.07	77.23	77.77	74.22	72.25	72.95	73.38	67.68	75.46	79.77	79.42	78.88	74.74	75.33	73.45	71.12	74.41	67.68
200	75.85	83.18	76.72	69.1	77.35	76.25	66.77	63.71	68.86	72.48	79.63	73.47	80.48	79.44	67.5	73.52	66.3	68.53	67.54	72.48
250	70.91	78.5	71.94	68.67	75.49	68.2	73.28	70.11	66.3	68.77	71.15	74.93	77.73	73.21	73.42	67.21	68.81	70.37	70.39	68.77
315	72.6	71.94	73.21	69.99	67.61	68.23	72.86	75.21	72.84	77.87	73.08	77.16	72.32	69.14	68.79	63.73	74.69	71.82	75.59	77.87
400	71.71	72.15	73.68	68.34	67.61	66.77	69.94	73.38	69.38	73.02	73.97	72.58	73.4	70.06	65.47	64.72	71.14	73.07	72.86	73.02
500	73.59	74.55	74.41	73.02	71.45	73.33	71.17	71.64	73.78	72.08	74.28	76.08	71.94	71.89	73.47	72.11	70.98	72.22	73.73	72.08
630	77.07	77.75	77.94	81.96	79.14	81.28	80.17	78.31	78.5	81.7	76.54	78.86	75.35	81.4	83.3	80.22	78.27	80.36	78.64	81.7
800	75.68	76.83	76.48	76.67	78.22	79.3	84.19	78.79	81.89	81.4	80.66	76.55	76.57	81.4	79.84	80.27	79.82	82.41	83.14	81.4
1000	73.61	72.86	73.23	75.49	76.83	74.18	76.57	79.51	75.8	77.59	75.36	74.43	77.37	75.05	73.38	75.21	77.21	76.74	76.39	77.59
1250	69.47	71.92	72.04	72.72	73.14	74.2	74.98	75.09	75.56	73.99	71.5	72.48	71.35	73.49	74.25	72.53	73	76.65	74.58	73.99
1600	69.21	74.15	70.88	75.09	75.26	75.96	79.35	76.27	76.72	75.07	73.41	73.78	72.08	75.66	76.79	74.32	75.7	76.36	75.73	75.07
2000	69.78	72.11	70.65	77.14	76.15	80.17	73.71	75.19	75.07	73.47	71.94	74.34	70.72	79.09	79.07	77.14	72.79	75.28	75.49	73.47
2500	72.76	71.21	70.46	74.11	75.8	77.84	69.12	69.24	72.22	71.12	70.97	74.36	74.98	76.15	74.53	73.14	71.26	71.02	70.74	71.12
3150	71.78	79.11	75.77	73.71	74.11	75.33	72.58	71.89	74.22	70.67	74.15	76.74	74.79	74.69	73.52	72.67	73.85	72.55	71.78	70.67
4000	70.11	78.76	75.21	72.6	74.18	74.74	73.61	73.59	74.9	67.87	74.48	73.99	75.26	75.73	73.52	72.32	75.45	74.6	73.23	67.87
5000	66.98	70.08	67.99	69.43	71.66	69.52	69.75	69.9	71.61	66.44	67.76	68.84	71.75	71.59	69.24	68.41	71.89	70.86	71	66.44
6300	66.46	70.93	67.92	70.27	71.52	69.31	66.09	65.47	67	63.33	66.52	70.08	70.32	72.36	69.61	68.04	67.07	66.39	66.34	63.33
8000	68.84	72.15	71.17	70.22	70.88	68.39	68.98	67.71	69.71	63.31	71.69	69.78	71.61	71.57	69.1	67.31	70.06	71.17	68.67	63.31
10000	63.92	67.54	66.49	64.39	68.2	65.31	62.04	61.95	66.18	57.24	65.84	65.62	67.99	67.78	64.53	62.98	66.18	65.03	62.06	57.24

Table A1.25 As measured sound pressure level data for the box source, Laboratory 1, first determination

Freq band	ISO 3744 microphone position (see Table 1)																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A-wt	82.8	68.4	68.5	75.0	77.0	65.3	67.1	79.4	66.9	67.7	65.9	77.2	78.5	66.9	66.7	81.8	73.3	66.4	74.2	69.3
50	60.8	59.3	60.7	60.4	64.1	58.6	60.3	59.5	65.0	65.0	59.7	63.0	63.6	61.0	58.6	61.8	58.8	58.7	59.8	59.2
63	63.8	61.0	59.5	61.8	67.7	59.6	60.9	62.4	59.9	59.9	63.2	63.1	63.6	60.6	60.5	64.1	61.5	58.5	61.3	60.1
80	78.0	72.9	73.5	76.3	75.8	71.5	72.9	76.0	72.3	71.8	72.2	77.3	75.4	72.3	73.8	76.7	73.6	71.6	75.3	72.1
100	78.2	72.0	70.8	75.6	75.6	72.8	72.0	76.2	71.6	73.2	73.4	76.0	75.5	72.1	71.5	77.1	74.5	72.0	75.3	72.6
125	70.2	63.3	62.2	66.2	67.7	64.2	63.1	67.4	62.3	62.2	64.7	66.7	67.6	62.9	63.2	68.9	65.5	62.5	65.6	63.7
160	67.8	60.0	60.3	65.1	66.6	61.2	60.7	66.0	60.1	60.4	61.7	65.4	66.2	60.9	60.2	67.6	64.5	59.8	64.8	61.7
200	68.9	58.6	60.1	63.9	65.2	60.4	58.1	65.2	58.6	57.6	61.0	65.0	65.5	59.6	59.4	67.7	63.8	58.6	62.8	60.0
250	71.7	61.5	60.4	66.5	66.4	59.7	59.3	64.4	60.3	58.9	61.3	68.1	68.9	60.4	59.4	68.7	65.0	57.4	63.2	62.1
315	72.1	61.9	61.1	65.2	64.5	57.0	58.2	61.8	56.9	56.3	59.3	67.2	67.5	60.0	60.6	68.8	60.8	55.3	61.0	57.7
400	69.0	60.9	61.6	64.3	62.9	54.1	57.1	60.4	53.4	53.6	56.0	66.6	66.3	57.8	59.0	66.5	54.8	54.0	59.7	53.6
500	70.1	61.5	60.3	63.5	64.1	55.8	55.3	63.4	56.1	56.7	54.3	66.4	67.6	59.6	57.9	67.5	59.7	56.2	59.3	57.1
630	71.9	60.1	60.5	62.9	60.5	53.1	55.0	64.5	54.0	58.4	53.6	66.8	67.1	56.1	55.0	62.5	59.6	54.7	61.5	60.3
800	71.4	58.6	58.2	60.9	61.0	51.5	55.4	62.9	54.3	54.7	52.7	64.8	66.3	53.7	53.2	64.6	59.3	53.5	61.2	55.2
1000	72.9	59.5	58.4	61.9	62.1	54.1	54.5	67.8	54.5	59.7	57.3	67.8	69.8	55.6	53.7	69.1	58.9	57.3	60.2	59.5
1250	75.3	59.2	60.3	63.1	65.0	56.4	58.3	70.9	57.7	57.8	56.8	67.0	67.8	55.2	56.0	70.7	63.3	58.6	63.8	59.2
1600	73.5	57.4	57.4	64.6	67.1	55.1	57.7	70.9	58.3	56.9	55.1	66.6	68.6	57.4	57.8	73.7	62.8	56.9	64.3	59.9
2000	69.5	54.0	55.5	63.9	68.5	54.5	57.5	69.3	57.5	57.3	53.5	64.5	66.1	56.7	56.0	73.0	63.2	54.9	64.7	59.4
2500	69.9	52.9	53.1	64.6	67.1	51.5	55.2	67.7	54.6	55.4	51.6	63.8	64.9	53.8	53.6	70.4	62.5	53.2	63.0	57.0
3150	69.7	51.9	53.3	65.2	66.7	51.3	52.9	68.9	52.8	54.9	51.5	66.0	67.1	53.2	52.8	71.3	62.7	52.0	63.4	56.5
4000	69.3	49.7	50.7	63.5	65.5	48.3	51.8	67.8	51.6	52.3	48.0	64.7	65.8	50.6	51.4	70.0	62.1	51.0	62.4	55.7
5000	68.6	47.7	47.5	61.1	63.5	46.1	48.9	65.5	48.7	50.0	44.9	63.9	65.4	48.9	49.3	68.5	59.8	47.1	60.6	53.5
6300	68.2	47.3	47.0	59.6	62.6	44.3	47.4	64.3	47.0	47.9	43.2	63.3	64.9	46.8	47.3	67.0	58.7	45.1	60.0	51.2
8000	64.3	42.9	43.4	57.6	60.8	41.5	44.6	61.8	44.9	44.8	40.1	60.0	61.5	44.4	44.9	64.7	56.6	42.4	57.5	48.7
10000	61.5	38.7	38.9	54.5	57.8	37.2	41.2	59.2	41.8	41.3	35.5	56.7	58.0	40.9	40.8	61.6	53.4	38.8	54.9	45.5

Table A1.26 As measured sound pressure level data for the box source, Laboratory 1, second determination

freq band	ISO 3744 microphone position (see Table 1)																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A-wt	82.0	68.4	68.7	76.5	76.5	65.1	67.0	79.8	66.9	68.6	65.9	76.6	79.0	67.5	67.4	82.1	75.1	66.8	73.5	69.5
50	62.3	65.0	59.4	65.0	62.5	65.0	65.0	60.7	65.0	65.0	58.6	65.0	62.8	60.4	62.2	61.0	60.4	60.4	61.2	65.0
63	64.2	60.4	60.1	61.9	63.4	63.4	58.5	63.0	59.6	60.5	58.6	62.2	64.5	60.1	62.9	63.9	62.8	59.3	62.5	60.1
80	79.4	73.8	74.9	76.9	75.5	72.5	73.4	76.6	73.3	73.5	72.0	78.1	76.4	71.3	75.5	77.8	74.7	73.2	76.6	73.4
100	78.3	71.6	71.3	75.9	75.6	72.9	70.9	75.9	71.4	73.6	74.1	75.4	76.3	73.0	72.0	77.6	74.5	72.7	73.9	72.8
125	70.0	63.6	64.5	66.9	67.5	64.3	62.1	67.3	62.0	64.0	66.4	67.0	68.5	62.6	63.5	69.3	66.6	62.8	66.0	64.0
160	68.7	60.7	60.4	65.8	66.0	61.4	59.6	66.3	59.9	61.6	62.6	65.7	66.6	61.5	61.2	68.1	64.7	60.5	64.8	61.7
200	69.1	59.2	60.7	64.2	65.1	61.1	58.2	65.8	58.6	59.6	61.4	64.4	65.7	60.0	59.9	68.0	64.0	57.7	63.2	59.9
250	70.5	60.8	60.3	65.3	65.2	59.2	60.7	65.1	60.2	60.5	60.9	67.2	68.0	61.4	59.0	69.0	64.0	57.2	64.1	61.5
315	71.1	61.1	61.5	65.0	64.0	57.7	59.7	61.0	57.8	56.6	60.2	66.5	67.7	60.2	59.6	68.4	60.8	55.2	60.2	58.2
400	68.9	61.4	62.8	63.5	63.2	54.6	54.9	60.2	51.8	52.8	55.9	66.0	66.3	58.4	59.2	64.2	57.2	53.6	58.2	54.8
500	70.5	61.8	61.1	62.9	64.8	55.0	54.8	64.2	56.3	58.2	55.1	66.9	68.1	58.5	58.8	66.7	59.8	56.6	59.4	56.2
630	70.4	59.7	61.0	60.4	60.3	53.1	54.5	63.7	54.0	58.5	54.3	66.6	67.2	57.0	56.6	64.5	60.9	56.0	60.4	59.5
800	71.9	58.3	58.2	60.7	60.8	50.8	55.0	63.6	54.6	54.9	53.1	65.0	67.0	55.2	54.1	64.6	60.9	54.4	61.1	55.8
1000	72.3	60.3	58.2	61.4	61.5	53.5	55.2	67.7	54.4	60.1	57.0	66.2	69.6	55.4	55.1	69.6	61.0	58.3	59.6	60.1
1250	73.2	58.2	59.5	65.3	65.3	56.2	57.9	71.1	57.4	58.6	56.3	65.4	66.9	57.5	57.2	70.8	65.2	57.9	63.9	59.4
1600	71.4	57.2	58.5	67.0	65.7	54.6	57.8	71.5	57.8	58.4	55.2	67.9	67.5	57.8	58.2	74.1	64.8	56.8	64.2	59.7
2000	69.6	54.2	55.0	67.1	67.9	54.3	57.4	70.2	57.5	58.8	53.5	63.3	66.8	56.7	57.0	73.5	64.7	55.7	63.8	59.7
2500	69.7	53.5	53.1	65.8	66.3	51.5	54.3	68.2	54.7	55.9	51.6	63.0	67.1	55.0	54.1	71.0	64.9	53.1	61.8	57.3
3150	69.7	52.6	52.9	66.3	66.4	51.1	53.1	69.0	53.4	55.8	50.1	65.2	68.2	53.3	53.7	71.6	65.0	52.8	62.2	57.0
4000	69.6	49.9	50.6	65.4	64.7	48.9	52.2	68.4	52.3	53.5	48.4	63.8	67.2	51.6	51.4	69.6	63.4	51.6	61.3	55.8
5000	69.2	47.9	48.0	63.8	63.5	47.0	49.4	66.0	49.0	51.8	45.0	63.2	68.6	50.1	49.6	68.4	62.6	48.5	59.8	53.1
6300	66.4	47.1	46.7	61.3	61.4	44.6	47.2	64.3	47.0	49.9	42.6	62.2	65.3	48.7	47.3	66.9	61.7	46.1	59.2	51.0
8000	64.2	42.6	43.2	59.5	59.5	41.5	44.5	61.8	44.5	47.1	40.2	59.2	62.1	45.7	44.6	65.0	59.4	43.1	56.4	48.2
10000	61.0	38.3	38.6	57.0	56.9	37.4	41.5	59.5	42.3	44.0	36.2	56.0	59.8	42.1	40.6	62.0	57.0	39.5	53.8	44.9

Table A1.27 As measured sound pressure level data for the box source, Laboratory 1, third determination

freq band	ISO 3744 microphone position (see Table 1)																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A-wt	82.3	68.9	68.7	75.6	76.9	65.2	67.0	80.2	66.7	69.6	65.6	77.2	79.1	66.8	66.7	82.2	74.9	66.6	73.8	69.6
50	63.5	58.9	65.0	61.8	59.2	65.0	65.0	60.4	65.0	65.0	65.0	58.8	58.9	65.0	65.0	59.0	65.0	65.0	61.0	65.0
63	64.0	61.2	59.8	64.0	63.2	59.6	59.0	63.1	59.8	60.2	60.1	62.2	63.4	60.5	60.0	63.6	62.0	58.8	62.3	60.1
80	78.4	73.7	73.4	76.4	75.5	72.2	71.8	76.1	72.2	72.4	72.1	77.1	76.0	73.2	73.3	77.8	74.6	72.2	74.8	71.9
100	76.8	69.3	69.8	76.0	73.8	70.5	69.8	75.0	67.8	71.8	70.8	74.5	74.8	69.2	70.6	76.1	73.3	69.7	74.1	71.3
125	69.6	63.6	63.8	66.9	67.8	64.1	61.9	67.4	61.7	63.6	66.1	67.1	68.4	63.3	63.8	69.2	66.2	63.5	65.9	63.8
160	67.1	59.5	58.2	65.5	65.8	61.1	57.7	65.7	58.0	59.9	61.6	65.1	65.7	59.4	59.2	67.0	63.8	59.2	64.1	59.9
200	69.2	59.2	59.6	64.4	65.7	60.3	57.7	66.6	57.8	59.6	61.3	64.3	66.2	58.7	59.7	68.8	64.2	58.8	63.2	58.6
250	72.1	62.3	61.1	66.3	66.2	59.8	60.5	67.6	61.0	61.9	60.9	69.1	69.4	61.1	59.6	70.5	65.0	59.7	63.8	60.3
315	72.2	62.8	61.1	64.3	63.9	57.6	59.8	64.5	58.9	56.5	58.4	67.0	68.0	60.3	60.0	69.3	60.8	57.0	60.7	56.2
400	68.9	60.3	62.6	64.5	62.6	54.2	56.0	57.5	54.4	52.6	55.6	67.0	65.8	56.7	59.0	64.6	56.4	53.9	59.9	53.5
500	69.7	61.8	59.6	62.1	64.7	55.2	55.1	63.3	55.9	58.2	54.3	66.3	68.2	58.5	57.5	65.5	60.2	56.9	59.3	57.3
630	71.3	60.6	61.0	60.1	60.3	52.8	54.4	64.8	53.4	59.5	53.6	67.1	67.6	56.6	55.3	64.6	60.7	55.3	61.8	58.5
800	71.2	58.3	59.0	60.3	59.6	50.9	53.5	64.2	54.2	53.6	52.7	65.4	67.0	54.1	53.1	64.7	59.6	53.3	60.9	54.3
1000	73.5	60.4	59.4	60.5	61.9	54.0	54.5	68.8	54.6	60.8	57.3	68.2	69.7	56.0	54.8	68.9	61.3	58.3	59.8	61.2
1250	73.1	60.7	58.4	63.5	64.9	56.7	58.4	71.0	56.1	59.6	56.1	67.7	69.8	55.2	56.1	70.9	64.7	58.1	63.4	59.7
1600	71.2	56.9	58.8	66.2	67.4	54.8	58.8	72.2	59.8	60.0	55.9	67.0	68.6	56.9	57.4	74.4	65.1	56.9	63.9	60.3
2000	70.4	56.3	55.6	66.6	68.1	54.6	57.0	70.9	55.9	60.6	54.6	65.8	67.9	56.6	56.5	73.7	65.5	55.0	64.2	60.5
2500	69.1	52.5	53.8	65.4	66.8	51.4	55.2	68.3	53.9	57.3	51.4	62.9	65.2	54.3	53.5	71.2	63.2	53.0	62.8	57.4
3150	70.0	52.0	53.5	64.8	67.0	51.1	52.7	68.5	53.0	56.7	48.6	65.0	67.4	52.7	53.0	71.1	64.2	52.4	62.6	56.9
4000	70.5	50.8	50.7	63.8	65.0	49.2	51.2	68.3	51.4	55.3	45.9	64.1	66.5	51.2	51.1	70.3	64.3	51.1	62.3	55.2
5000	69.2	48.5	48.1	62.1	63.7	46.7	49.0	66.4	49.1	52.5	43.3	62.3	66.3	49.2	49.2	68.4	62.3	47.5	60.4	52.7
6300	67.0	47.3	47.3	61.3	62.9	44.6	46.0	64.4	47.2	51.2	41.4	62.1	65.8	47.3	46.9	67.4	60.5	44.8	59.3	51.3
8000	64.9	43.2	43.7	59.5	61.0	41.6	44.1	62.5	44.8	47.7	39.2	59.8	62.5	44.5	44.4	64.9	58.8	42.1	56.8	47.8
10000	61.6	39.1	39.5	56.7	58.0	38.0	40.4	59.8	41.0	44.6	35.9	56.5	59.0	40.9	40.6	62.0	56.0	38.9	53.9	44.7

Table A1.28 As measured sound pressure level data for the box source, Laboratory 2, first determination

freq band	ISO 3744 microphone position (see Table 1)																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A-wt	82.1	67.3	67.5	76.2	75.6	63.9	66.1	78.9	66.0	67.1	63.3	77.4	77.2	65.7	66.1	81.7	72.6	65.2	73.2	67.2
50	60.2	59.0	56.4	63.2	61.5	58.1	56.3	59.5	62.9	65.9	56.2	58.1	63.3	65.3	58.4	59.4	61.2	61.7	58.1	59.3
63	64.2	60.8	59.8	63.1	63.3	60.4	59.6	63.3	62.6	66.1	59.6	62.3	63.8	62.8	60.0	64.0	62.9	61.5	61.9	61.0
80	78.8	73.0	74.1	77.6	75.6	72.4	73.5	76.9	72.6	73.6	72.4	78.1	75.7	72.8	74.0	78.4	75.0	73.0	76.3	73.9
100	78.5	71.7	71.8	75.4	75.5	72.7	72.1	76.3	71.9	72.4	72.5	75.9	76.0	72.1	72.3	77.8	74.6	71.5	74.6	72.5
125	70.4	62.8	61.5	66.7	67.7	63.8	61.7	67.7	62.9	63.2	64.3	67.0	68.0	62.8	61.9	69.4	66.0	62.2	65.7	63.2
160	67.8	59.6	59.5	65.3	65.1	60.5	59.5	64.7	59.5	60.6	61.1	65.8	65.4	59.5	59.6	67.1	63.1	59.3	63.6	60.4
200	69.3	59.5	60.6	64.9	64.5	61.1	58.3	64.7	57.7	57.8	62.0	65.6	65.3	58.9	59.7	68.0	62.1	58.4	62.6	57.5
250	71.3	59.5	59.8	66.3	66.2	58.9	58.7	65.1	58.6	58.8	60.0	67.7	67.2	59.1	59.6	69.4	63.2	56.5	63.6	58.5
315	71.5	61.0	61.1	65.1	64.8	56.7	57.5	63.1	57.6	54.8	58.2	66.5	66.7	60.0	60.1	68.8	60.8	54.5	60.8	53.9
400	69.3	61.1	62.5	64.1	63.0	53.2	53.4	58.1	53.0	52.6	55.2	67.4	65.8	58.3	59.8	65.9	55.5	50.5	56.4	51.9
500	70.3	60.8	60.2	62.2	63.0	54.6	54.1	62.7	54.6	56.9	52.9	66.4	67.3	57.2	56.3	67.0	58.3	55.4	58.5	56.9
630	71.2	58.3	58.5	59.4	59.6	51.8	54.3	64.7	53.2	57.4	50.9	66.1	65.5	53.2	53.7	63.7	59.7	54.5	60.3	57.3
800	72.5	57.1	56.9	59.5	59.3	49.2	54.7	63.5	54.7	53.1	51.0	65.3	64.8	53.3	51.3	65.5	59.7	53.4	61.4	53.2
1000	72.6	59.1	59.1	60.8	60.5	52.9	54.2	68.0	54.2	59.2	56.6	68.1	67.8	52.8	53.6	69.4	59.5	56.2	59.9	59.4
1250	73.1	57.7	58.5	65.4	64.2	55.2	57.4	70.5	57.2	56.6	52.9	67.0	66.8	55.0	55.6	71.5	63.7	56.5	63.7	56.7
1600	71.6	55.1	55.1	66.4	65.2	51.8	55.8	70.4	55.8	55.6	49.6	66.9	66.5	55.7	57.3	74.5	62.0	54.7	62.5	55.9
2000	69.5	51.6	51.6	66.8	67.0	52.1	55.7	68.5	56.2	56.5	50.0	64.1	63.5	54.7	54.2	72.0	62.2	54.8	62.7	57.0
2500	70.2	52.0	51.8	66.9	66.2	50.0	54.9	68.3	54.7	54.6	47.2	65.7	64.8	53.9	53.8	71.2	62.3	51.4	63.2	54.9
3150	68.7	49.5	49.2	65.1	64.4	48.5	51.7	67.3	51.6	54.2	43.8	65.8	65.4	50.5	50.5	70.3	61.0	50.5	62.2	54.4
4000	69.3	47.6	48.1	64.6	64.2	46.1	50.2	66.4	50.0	52.6	41.7	65.1	65.1	49.2	49.7	68.6	60.6	49.2	61.2	52.7
5000	69.0	46.5	47.1	62.6	61.7	43.7	47.2	65.1	47.4	50.1	40.0	64.8	65.1	47.4	47.7	66.7	58.5	46.0	59.6	50.3
6300	66.8	45.4	45.4	60.4	60.2	41.4	44.3	62.0	44.5	47.2	37.6	62.9	63.5	44.8	45.5	64.9	56.3	42.3	57.4	47.3
8000	64.3	41.3	41.3	58.8	58.5	38.6	42.5	60.1	42.4	45.2	35.3	60.1	59.8	42.3	42.6	63.4	54.5	39.2	55.7	45.1
10000	61.3	36.8	36.5	56.2	55.7	34.0	39.3	56.6	39.2	42.2	31.1	57.1	56.9	38.2	38.5	60.5	51.5	35.5	52.6	42.2

Table A1.29 As measured sound pressure level data for the box source, Laboratory 2, second determination

freq band	ISO 3744 microphone position (see Table 1)																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A-wt	82.0	67.1	67.6	76.4	75.6	63.8	66.2	79.2	66.3	67.5	63.2	77.8	76.9	65.4	66.0	81.8	72.2	65.1	73.1	67.4
50	60.0	58.1	54.6	56.9	60.7	56.4	55.2	59.2	58.5	57.7	58.6	58.8	61.8	58.5	56.2	60.2	59.2	56.1	59.3	58.3
63	64.6	60.6	59.8	63.2	63.6	59.5	60.7	63.0	60.6	60.7	60.3	62.5	64.0	60.4	59.2	64.2	62.8	59.1	62.2	60.6
80	77.7	71.8	73.5	75.9	74.5	71.1	72.3	75.2	71.4	72.3	71.9	76.8	74.3	70.9	72.8	77.0	73.3	70.3	74.6	72.0
100	77.8	71.0	71.3	75.1	75.0	71.6	71.3	75.8	71.3	72.0	72.1	75.2	75.4	71.5	71.6	77.2	73.6	71.4	73.8	72.2
125	69.3	62.2	61.9	66.2	67.0	63.8	61.8	67.2	62.2	62.9	64.2	66.8	67.5	62.6	61.7	69.2	65.8	62.0	65.2	62.7
160	67.6	59.1	59.4	64.8	64.7	61.1	59.4	64.9	59.5	60.8	61.0	65.9	65.5	58.8	59.8	67.0	63.2	58.5	63.5	60.7
200	69.3	58.8	59.6	64.9	64.7	60.1	57.8	64.8	57.3	58.0	61.4	65.7	65.7	58.1	59.8	68.2	62.6	57.2	62.4	57.9
250	71.1	59.8	60.9	66.8	66.3	59.1	59.1	65.1	59.0	58.6	59.9	67.9	67.4	59.6	60.6	69.4	63.2	56.8	63.7	58.7
315	71.3	60.9	61.4	65.2	64.8	57.1	57.5	63.4	57.7	54.1	58.2	66.6	66.6	59.8	60.6	68.8	60.4	54.7	60.6	53.9
400	69.2	60.8	61.4	62.9	62.5	53.1	52.8	58.6	52.4	51.9	54.6	66.1	65.3	57.3	58.3	66.0	55.7	50.7	55.8	51.9
500	70.6	60.7	60.7	62.4	62.6	54.2	54.5	63.1	54.4	57.0	51.9	66.8	67.2	56.2	56.9	66.9	58.3	55.7	58.7	57.2
630	71.0	59.4	59.8	60.7	59.7	51.2	54.3	64.7	53.6	57.8	50.2	67.2	65.7	53.4	54.4	63.6	59.3	54.2	60.7	57.8
800	72.3	57.3	56.9	60.0	59.3	49.4	54.5	63.6	54.7	54.6	50.4	65.5	64.5	51.7	51.6	65.9	59.3	51.4	60.9	54.6
1000	72.6	58.4	59.0	61.1	60.8	52.2	54.4	68.3	54.5	59.7	56.2	68.2	67.8	52.9	52.7	69.9	59.2	56.8	60.4	59.6
1250	72.6	56.5	58.1	64.9	63.5	55.3	58.1	70.9	57.8	57.1	52.4	67.3	66.5	54.2	54.9	71.3	62.9	56.4	63.5	56.8
1600	70.4	54.8	54.3	67.1	65.5	52.0	56.1	70.5	56.5	56.1	48.7	66.8	66.2	55.8	56.9	74.7	61.8	54.6	62.1	55.9
2000	69.2	52.4	52.7	67.3	67.2	52.8	55.8	69.1	57.0	56.9	49.7	64.5	64.0	55.1	55.0	72.0	61.7	54.9	62.5	56.8
2500	70.2	52.3	52.6	66.4	65.6	50.2	54.5	68.6	54.6	55.5	46.6	66.1	64.3	53.5	53.7	70.9	61.9	51.1	62.9	55.5
3150	69.4	50.1	50.0	65.6	64.5	48.6	52.3	67.3	51.4	54.8	43.4	66.7	65.2	50.9	50.9	70.6	61.1	50.7	61.9	54.8
4000	70.4	48.0	48.2	64.6	64.4	46.6	50.3	66.6	50.1	53.1	41.5	65.9	64.6	49.2	49.9	68.7	60.5	48.8	61.3	53.1
5000	69.1	46.9	48.0	63.2	62.1	44.3	47.9	65.1	47.4	51.0	39.7	65.9	64.4	47.7	47.8	67.2	58.2	45.7	59.7	51.0
6300	66.3	45.7	46.1	61.0	59.9	42.3	44.8	62.2	44.3	47.7	37.9	63.5	62.6	45.4	45.5	65.4	56.0	42.3	57.4	47.6
8000	64.4	41.4	41.7	59.3	58.6	39.6	42.6	60.3	42.3	45.6	35.9	60.6	59.1	42.9	42.8	63.7	54.1	39.6	55.6	45.6
10000	61.4	37.1	37.5	56.8	55.7	35.7	39.7	57.0	39.2	43.8	32.0	57.9	56.4	39.3	39.0	61.2	51.3	35.9	52.7	43.7

Table A1.30 As measured sound pressure level data for the box source, Laboratory 2, third determination

freq band	ISO 3744 microphone position (see Table 1)																			
A-wt	82.1	67.5	67.7	76.5	75.8	64.0	66.3	79.1	66.1	67.5	63.5	77.9	77.3	65.5	66.0	81.7	72.4	65.3	72.9	67.5
50	59.3	60.0	56.2	57.3	60.4	55.7	56.4	64.2	58.4	57.1	54.8	58.5	61.4	58.1	56.9	60.9	59.2	55.5	55.7	56.9
63	64.5	64.9	60.0	62.5	63.2	63.2	60.6	63.1	60.8	61.1	59.7	62.8	64.0	60.2	61.3	65.1	62.4	59.5	61.6	60.2
80	77.3	71.5	72.8	75.3	74.2	71.1	71.7	74.8	71.1	72.2	71.1	76.0	74.0	70.8	72.2	76.3	73.0	70.9	74.4	71.8
100	77.8	71.9	71.6	75.1	74.9	71.7	71.3	75.2	71.3	72.1	71.9	75.5	75.3	71.3	71.3	77.3	73.8	70.6	73.8	72.2
125	69.9	62.9	62.3	66.7	67.3	64.1	62.3	67.7	62.6	62.9	64.0	67.1	67.9	62.4	62.7	69.5	66.1	62.3	65.1	62.9
160	67.7	59.7	59.6	65.2	64.9	60.9	59.2	64.8	59.1	60.4	61.2	66.0	65.6	58.9	59.3	67.0	63.0	58.9	63.6	60.4
200	69.2	59.1	60.0	64.7	64.8	60.3	57.7	64.9	56.9	58.0	61.6	65.5	65.6	58.3	59.4	67.8	62.6	57.2	62.5	57.9
250	71.3	60.1	60.6	66.6	66.6	59.4	59.2	65.1	58.8	58.5	60.3	68.0	67.6	59.9	60.3	69.3	63.4	57.0	63.7	58.5
315	71.6	61.1	61.6	65.3	64.9	57.4	57.8	63.3	57.4	54.1	58.7	66.8	66.7	60.2	60.6	69.0	60.6	54.8	60.7	54.2
400	69.5	60.5	60.9	63.2	62.4	53.1	53.1	58.5	52.0	51.9	54.8	66.3	65.4	57.2	58.2	65.8	55.9	50.6	55.9	52.0
500	70.8	60.6	60.7	62.4	62.8	54.5	54.4	63.2	54.5	57.0	52.2	67.1	67.3	56.4	56.8	67.0	58.4	55.5	58.6	57.2
630	71.2	59.6	59.9	60.7	59.9	51.2	54.7	64.8	53.3	57.8	50.8	67.3	65.9	53.9	54.4	63.5	59.7	54.4	60.7	57.9
800	72.6	57.5	57.0	60.0	59.6	49.7	54.5	63.6	54.3	54.7	51.1	65.6	64.7	52.0	51.8	65.6	59.5	51.7	60.9	54.7
1000	72.7	58.9	59.2	61.1	60.6	52.2	54.3	68.4	53.8	59.8	56.3	68.5	68.0	53.0	52.8	69.9	59.3	57.0	60.2	59.7
1250	73.0	57.4	58.6	65.3	63.8	55.5	58.4	70.9	57.8	57.0	53.0	67.5	66.9	54.3	55.4	71.5	63.1	56.4	63.5	56.9
1600	70.9	55.0	55.3	67.1	66.0	52.4	56.2	70.5	55.9	56.1	49.4	67.1	66.4	55.7	57.0	74.6	62.2	55.0	61.8	56.1
2000	68.8	53.0	52.9	67.1	67.5	52.7	55.8	68.6	57.0	57.2	50.0	64.9	64.3	55.2	55.2	71.4	61.8	55.5	62.1	57.1
2500	70.4	52.9	52.7	67.2	65.4	50.6	54.5	68.6	54.5	56.2	47.2	66.2	65.1	53.8	54.1	71.3	62.4	51.4	62.9	56.0
3150	69.1	50.9	50.0	65.0	65.1	48.6	52.1	67.3	51.3	54.8	44.8	66.5	65.5	51.2	50.7	70.2	61.1	50.9	61.6	54.7
4000	70.1	48.5	48.3	65.0	64.0	46.6	50.4	66.3	50.4	52.8	42.2	65.5	65.2	49.0	49.9	68.7	60.5	49.2	61.1	52.6
5000	68.8	47.4	47.5	63.1	62.4	44.5	47.5	64.8	47.5	50.4	40.4	65.5	65.2	48.2	47.9	67.2	58.3	46.2	59.2	50.2
6300	66.5	46.4	46.0	60.8	60.1	42.4	44.9	62.1	44.3	46.6	38.9	63.7	63.5	45.2	45.9	65.5	56.3	42.9	57.0	46.3
8000	64.5	42.3	42.2	59.5	58.9	40.2	42.9	60.2	42.4	45.2	37.3	61.0	60.2	42.9	43.3	63.7	54.2	40.4	55.5	44.9
10000	61.4	38.4	37.8	57.0	56.2	36.0	39.6	56.9	39.2	43.6	33.7	58.2	57.6	39.6	39.6	61.3	51.0	36.9	52.5	43.4

Table A1.31 As measured sound pressure level data for the box source, Laboratory 3, first determination

	ISO 3744 microphone position (see Table 1)																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A-wt	82.6	68.1	68.5	76.2	76.4	63.9	72.8	79.8	66.9	68	64	77.5	77.8	66.1	66.4	82.4	72.1	66	67	68.3
50	59.1	58.1	52.8	55.1	60	53.2	54.6	58	56.9	56.1	55.5	54.6	60.2	57.5	52.4	58.9	59.4	54.4	52.2	56.6
63	65.2	60.6	59.3	62.1	63.4	58.9	62.1	63.8	61.1	61.2	59.4	62.6	64	60.3	60	64.6	62.5	59.3	59.5	60.9
80	77.9	70.1	73	76.3	74.5	70.9	75.3	75.9	70.7	73.4	71.7	76	74.1	69.9	72.6	77.2	73.2	71.3	73.2	74.3
100	79.2	73.1	73.8	76.9	76.8	73.1	75.6	77.7	72.5	74.2	74	76.9	77.3	72.8	73.1	79	75.3	72.9	73.7	75
125	70.8	64	64.5	67.2	67.4	64.9	65.5	67.9	62.2	63.8	64.8	67.9	68.4	63.5	63.5	70.3	66.2	63	62.8	64.1
160	68.3	58.8	58.7	65.4	65.3	60	64.3	65.3	59.6	62	61.1	65.8	66.6	58.8	58.9	67.6	64.1	58.8	58.7	62.1
200	69.5	59	59.9	64.9	64.4	60.7	63.4	65.1	57.8	59	61.7	66.2	65.9	57.9	58.5	68	62.4	57.8	58.5	59.5
250	71.7	60.3	60.2	66.7	66.8	58.5	63.6	65.7	59.1	58.7	60	68	68.6	59.7	59.4	69.8	63.3	57.4	59.3	59.6
315	72.2	61.4	61.2	66.3	66.1	57.8	62.8	64.4	59	55.4	59.3	67.5	68	60.4	60.8	69.9	61.9	56.8	58.6	54.9
400	69.4	61.9	62.7	64.4	62.8	53.3	56.8	57.8	54.6	52.4	54.7	67.2	66.4	58.7	60.3	66.4	56.3	50.5	55	52.9
500	71	60.6	61.6	62.7	62.9	53.7	58.9	63.1	54.8	57	52.5	67.2	67.7	57.1	57.4	67	58.9	55.3	55	57.2
630	71.3	60.2	59.8	60.8	60.1	51.3	60.2	65.3	54.1	57.8	50.4	67.1	66.9	53.6	54.5	63.4	59.7	54.7	54.3	58.4
800	72.4	59.3	58.3	60.6	60.4	49.4	61.2	64.1	54.2	53.6	50.5	65.2	65.7	53	52.3	66.5	59.1	52.7	54.5	54
1000	73.8	60.3	60	61.2	61.6	52	58.8	68	54.6	59.4	57.1	68.4	69.1	53.8	53.7	71.5	58.9	57.3	54.6	59.5
1250	73.6	58.4	59.7	65	64.7	54.3	63.5	70.4	58.8	58.8	53.3	67.1	67.3	55.2	54.6	72.5	62.6	58.2	58.8	58.5
1600	71.3	56.9	57.4	67	66.7	52.9	63.3	71.7	57.9	58.1	50.4	67.6	66.8	56.9	57.5	75.6	62.3	57	58.2	58.3
2000	69.5	52.8	53.8	67.2	67.7	52.7	62.4	70.1	57.3	58.1	51.5	64.3	64.7	56.1	55.7	71.8	61.9	55	57	58.5
2500	70.6	52.8	53.4	65.9	66.5	51.6	62.4	69.5	55.8	56.3	48.8	65.2	65	54.1	54.4	71.7	61.4	52.7	55.7	56.9
3150	70.6	51.9	52.3	65.9	66.1	50.5	61.6	68.9	53.1	54.9	46.8	66	66.4	52.9	52.5	71.5	61.4	51.7	53.1	55.5
4000	71.2	49.3	50.9	64.1	64.8	47.9	60.4	67.5	51.1	53.6	45.1	65.2	66	50.2	50.8	69.3	59.7	50.7	51.6	53.6
5000	70.2	48.3	49.6	63.1	63.1	46.4	59.2	66.6	48.8	51.2	43.7	65.2	66.1	48.8	49.3	68.1	58.3	47.8	49.9	52.3
6300	67.7	47.7	47.8	61.3	61.8	44.4	57.8	64.9	46.9	48.7	41.9	63.7	64.5	46.6	47.4	66.5	56.8	45	47.6	49.2
8000	65.8	43.9	44.6	59.5	59.8	41.5	54.7	62.4	44.2	45.5	39.3	60.4	60.8	44	44.3	64.5	53.6	42.2	45.7	46.3
10000	62.5	40.1	40.6	57.2	57.2	38.1	51.7	59.8	41.5	42.6	35.9	57.5	58.4	40.4	40.9	62	50.5	38.9	42.7	43.8

Table A1.32 As measured sound pressure level data for the box source, Laboratory 3, second determination

freq band	ISO 3744 microphone position (see Table 1)																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A-wt	82.6	68.1	68.4	76.1	76.9	63.8	72.9	79.9	66.9	68	64	77.5	77.7	66.2	66.4	82.7	72	66.1	67	68.3
50	59.3	57.4	51.6	55.5	60.1	53.2	54.9	58.4	57.3	56.7	53.8	54.5	61.1	57.3	52.7	59.2	59.3	54.2	52.6	56.2
63	65.3	61	59	61.9	63.1	58.3	62.2	63.9	64.8	61.1	59.5	62.7	63.3	60.2	59.1	65.6	62.3	59.4	59.4	60.4
80	77.1	71.3	72.8	75.5	74.3	71.4	75	76.9	71.1	74.3	71.6	76.3	74.1	70	72.6	77.7	73.4	71.6	73.3	73.7
100	79.7	73.9	73.7	76.5	76.7	73.6	75.8	77.9	72.8	74.9	73.8	76.6	76.7	72.8	73.4	79.4	75.1	72.8	73.5	74.8
125	70.7	63.8	64.2	66.7	67.7	65	65.6	68.3	62.5	63.6	65	67.8	68.7	63.4	63.1	70.3	66	63.3	62.9	63.9
160	68.2	59.5	58.5	65.6	65.8	60	64.5	65.3	59.5	61.8	61.4	66	66.2	58.8	58.9	67.9	64.1	58.6	58.9	62.6
200	69.1	59	60.2	65	64.8	60.7	63.1	64.9	57.1	58.9	61.8	65.9	65.9	58.4	59.4	68.6	62	58	58.1	59
250	71.7	60.5	60.3	66.9	67	58.5	64.2	65.7	59.9	59.3	60.3	67.9	68.5	59.8	59.3	70.2	63.7	57.5	59.4	59.4
315	72.3	61.6	61.3	66.3	66	58	62.8	64.5	58.6	54.9	58.9	67.7	68.1	61.2	61.2	70.1	61.6	56.3	58.8	55.1
400	69.7	61.8	62.3	64.5	63	53	57.3	57.6	53.4	54.2	54.6	67.1	66.1	58.7	60.8	66.6	56.3	50.9	55.2	53.1
500	71	60.9	61.2	62.5	63.1	53.4	58.9	63.2	54.2	57.4	52.5	67	67.4	57	57.4	67.2	58.7	55.7	54.9	57.1
630	71.1	60.2	59.8	60.6	60.1	50.8	60.5	65.4	53.8	57.9	50.4	67.1	66.7	53.7	54.4	63.6	59.6	54.8	54.3	58.3
800	72.2	59.3	58.2	60.4	60.8	49	61.2	63.8	54.3	53.7	50.4	65.3	65.6	53.2	51.9	66.7	58.9	52.5	54.7	53.8
1000	74	60.1	60	61.2	61.9	52.1	58.6	68.1	54.5	59.3	57.2	68.3	69	53.8	53.8	71.6	59	57.2	54.5	59.5
1250	73.7	58.1	59.7	64.9	65.2	54.3	63.3	70.5	58.6	58.4	53.3	67.2	67.1	55.1	54.7	72.6	62.7	58.3	58.9	58.5
1600	71.5	56.6	57.5	67.1	67.5	52.5	63.4	71.9	57.8	58.1	50.1	67.4	66.6	56.9	57.5	75.9	62.3	57.1	58.2	58.1
2000	69.5	52.7	53.5	67.1	68.4	52.7	62.6	70.1	57.4	58	51.4	64.2	64.5	56.2	55.7	72.1	61.7	55	57	58.4
2500	70.3	52.8	53.4	65.8	67.2	51.5	62.4	69.5	55.9	56.1	48.8	64.9	65.2	54.2	54.3	72.1	61.5	52.6	55.7	56.9
3150	70.4	51.8	52.1	65.7	66.7	50.4	61.8	68.9	53.3	55.1	47	66.2	66.7	53	52.4	71.7	61.4	51.5	53	55.4
4000	71	49.5	50.8	64.1	65.3	47.5	60.6	67.7	51	52.7	45.3	65.1	66.3	50.2	50.6	69.6	59.6	50.6	51.5	53.4
5000	69.9	48.5	49.6	63	63.7	46	59.3	66.7	48.8	51.7	43.8	65.2	66.2	49	48.9	68.5	58.1	47.5	49.8	52.3
6300	67.6	47.8	47.8	61.2	62.4	44	58.1	65.1	46.9	48.9	42.1	63.9	64.4	46.8	47.1	67	56.7	44.8	47.7	49.1
8000	65.5	43.9	44.3	59.2	60.4	41.2	55	62.6	44.2	46.3	39.5	60.5	60.7	44.1	43.9	64.9	53.5	42	45.8	46.2
10000	62.2	40	40.3	56.9	58	37.6	52.1	60	41.5	43.6	36.2	57.8	58.2	40.7	40.6	62.5	50.4	38.7	42.8	43.7

Table A1.33 As measured sound pressure level data for the box source, Laboratory 3, third determination

freq band	ISO 3744 microphone position (see Table 1)																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A-wt	82.6	68.2	68.5	75.9	77	63.8	73	79.9	67	68	64.1	77.3	77.8	66.2	66.5	82.5	72.2	66	67.1	68.3
50	59.3	58.1	51.4	54.5	60.2	53.5	54.9	58	56.8	56.9	53.7	54.9	60.8	57	53.1	59.3	59.7	53.8	53.2	56.5
63	65.6	59.8	59.1	62.7	63.4	58.3	62.2	63.4	64.6	61.9	58.9	62.7	64	60.2	59.5	65.3	62.5	59.2	59.9	61.5
80	78	70.1	73	75.8	74.5	71.5	74.5	76	71.9	73.8	71.6	76	73.8	70.3	72.8	77.6	72.9	71	73	74
100	79.7	73	73.5	76.3	76.9	73.8	75.4	77.5	72.5	75.2	74.2	76.8	76.9	72.6	73.2	79.2	74.9	72.9	73.2	75.3
125	70.8	63.3	64.3	66.8	67.5	64.7	65.7	68.2	62.6	63.4	65.2	67.7	68.7	63	63.2	70.3	66.1	63.3	62.5	63.9
160	68.1	58.9	58.8	65.2	66	59.7	64.7	65.4	59.6	62	61.3	65.4	66.4	58.7	58.9	67.5	64.1	58.6	59.1	62
200	69.5	58.9	60.1	65	65.1	60.6	63	65	57.1	59	61.9	66.1	65.8	58.3	59.3	68.3	62.1	57.7	58.4	59.2
250	71.8	60.2	60.2	66.5	67	58.8	64.6	65.8	60.1	59.2	60.4	67.9	68.4	59.6	59.4	70.3	64.4	57.1	58.9	59.4
315	72.2	61.2	61.1	66.3	65.8	57.9	62.3	64.1	58.5	55	59.4	67.4	67.7	60.5	61	70	60.8	56.1	58.9	55.1
400	69.6	62.2	62.3	64.4	63.2	53.1	57.7	58	53.4	53.2	55	67.3	66.4	59	60.8	66.3	55.3	50.7	55.2	53.4
500	71.1	61.2	61.4	62.5	63.1	53.6	58.7	63.1	54.7	57.1	52.6	67	67.8	57.3	57.6	67	58.2	55.9	55	57.5
630	71	60.4	59.8	60.7	60.3	50.9	60.6	65.4	54.3	57.9	50.6	66.9	67	53.9	54.5	63.4	59.9	54.8	54.3	58.3
800	72.2	59.2	58.3	60.3	60.7	49.3	61.4	64.2	54.5	53.6	50.2	65.2	65.6	53	52.3	66.4	59.3	52.5	54.5	53.8
1000	73.9	60.2	60.2	61	61.8	51.8	59	68.2	54.7	59.2	57.1	68.3	69.1	53.9	53.8	71.5	59	57.4	54.6	59.5
1250	73.7	58.3	59.7	64.7	64.9	54.3	63.5	70.5	58.8	58.4	53.2	67.1	67.3	55.1	54.6	72.4	62.6	58.1	59	58.4
1600	71.7	56.8	57.3	66.7	67.8	52.6	63.4	71.9	58.1	58.1	50.2	67.2	66.7	57.1	57.5	75.5	62.7	57	58.2	58.1
2000	69.7	52.7	53.7	66.9	68.6	52.6	62.6	70.3	57.8	57.9	51.3	63.8	64.7	56.1	55.8	72	61.6	55	57.1	58.5
2500	70.4	52.9	53.4	65.6	67.2	51.5	62.6	69.4	55.8	56	48.7	64.6	65.1	54.1	54.5	71.9	61.7	52.7	55.7	56.9
3150	70.4	51.9	52.2	65.7	66.7	50.3	62	68.8	53.5	55	46.9	65.8	66.7	53	52.6	71.7	61.5	51.6	53	55.5
4000	70.9	49.7	50.7	63.9	65.3	47.3	60.7	67.6	51.2	52.7	45.2	64.8	66.3	50.3	51	69.5	59.9	50.7	51.5	53.5
5000	69.9	48.7	49.7	62.7	63.9	45.9	59.3	66.6	49	51.7	43.7	64.9	66.2	49.1	49.4	68.4	58.5	47.6	49.8	52.2
6300	67.8	47.8	47.8	61	62.7	43.9	58.1	64.9	46.9	48.9	41.9	63.4	64.5	46.8	47.4	66.8	56.9	44.8	47.8	49.1
8000	65.5	44	44.2	59.1	60.6	40.9	55.1	62.6	44.2	46.3	39.3	59.9	60.8	44.3	44.4	64.7	53.9	41.9	45.8	46.2
10000	62.3	40	40.3	56.8	58.2	37.4	52.2	59.9	41.6	43.6	35.9	57.2	58.3	40.8	41.1	62.3	50.8	38.6	42.8	43.7

Table A1.34 As measured sound pressure level data for the box source, Laboratory 4, first determination

freq band	ISO 3744 microphone position (see Table 1)																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A-wt	82.5	67.9	68.3	75.4	76.5	64	67.6	79.5	67.1	68.7	65	78	78	66.3	66.6	81.2	72.9	66.1	72.5	68.7
50	64.42	62.56	61.66	63.19	62.89	60.23	62.35	61.71	61.59	62.7	63.36	70.08	63.03	62.86	63.47	65.64	66.32	63.52	62.32	62.7
63	65.14	62.96	62.58	67.52	64.35	60.32	62.63	64.11	63.03	63.59	63.1	76.06	63.36	63.03	60.58	67.76	68.08	62.72	62.7	63.59
80	78.17	70.62	72.74	75.19	73.85	71	72.62	75.77	71.64	71.66	70.98	77	74.34	71.09	72.36	76.81	73.82	71.31	74.93	71.66
100	76.93	69.82	70.25	74.69	74.41	71.64	72.34	76.5	71.35	71.85	70.2	74.08	74.22	71.12	71.26	76.97	74.29	72.04	74.29	71.85
125	69.92	63.43	63.5	66.34	66.89	62.89	62.72	67.61	62.7	62.37	65.12	67.68	67.97	63	61.92	69.14	65.97	63.24	65.12	62.37
160	67.52	59.36	59.67	64.39	64.7	60.54	60.18	64.98	59.99	60.58	62.16	65.59	64.82	61.19	59.97	67.57	63.24	59.24	63.1	60.58
200	68.93	58.42	59.27	64.3	64.49	60.09	58.11	65.05	57.27	59.69	61.1	65.76	64.89	57.43	58.32	68.39	62.89	57.45	62.93	59.69
250	71.33	60.54	59.83	65.97	66.27	58.87	60.23	65.94	60.79	61.52	61.33	67.5	67.99	60.18	59.97	69.03	64.09	57.43	63.85	61.52
315	71.82	60.94	60.09	65.38	65.71	57.48	59.29	63.9	57.74	56.68	58.11	66.84	66.2	60.84	60.94	69.03	60.89	57.41	61.26	56.68
400	68.48	60.14	61.17	63.66	63.08	53.62	54.47	58.18	53.17	51.79	56.07	66.18	64.93	58.23	59.83	65.43	57.67	51.55	56.91	51.79
500	70.62	60.79	62.16	62.89	63.4	53.74	56.7	62.35	54.66	57.76	55.13	67.5	67.26	57.48	58.82	65.97	58.82	54.84	59.17	57.76
630	71.35	59.34	59.92	61.43	60.84	51.5	55.86	65.54	54.77	59.62	53.57	67.1	66.91	54.47	55.57	63.38	60.63	55.24	61.12	59.62
800	72.62	57.97	57.78	61.33	61.43	49.29	57.08	64.04	54.96	54.26	53.76	65.85	66.3	53.76	52.87	65.8	61.08	55.06	61.85	54.26
1000	74.6	61.43	60.86	60.3	61.12	52.52	57.95	68.37	56.42	59.83	59.05	69.31	70.06	53.97	54.56	70.72	59.38	58.23	58.94	59.83
1250	74.2	58.65	59.9	65.1	65.36	54.09	59.52	71.07	58.32	60.91	54.91	67.47	68.13	54.42	55.1	71.96	62.96	56.77	62.93	60.91
1600	69.19	55.08	54.3	64.49	65.31	51.62	57.08	70.48	57.71	59.03	49.18	65.1	65.97	55.86	56.35	72.41	61.99	55.34	61.55	59.03
2000	65.19	50.56	50.61	66.74	68.63	54.02	56.44	69.54	57.2	58.3	49.01	60.91	62.63	57.24	57.43	71.19	62.65	55.46	61.9	58.3
2500	69.31	52.26	51.81	64.06	65.24	51.18	55.06	69.38	54.68	55.57	49.36	65	64.56	53.72	53.32	69.64	62.21	52.54	61.9	55.57
3150	73.07	53.15	53.39	65.78	66.93	51.69	54.26	67.28	54.23	54.21	51.36	69.64	68.25	53.48	52.84	70.98	61.43	52.23	60.49	54.21
4000	70.34	48.8	50.09	63.19	64.67	47.37	51.55	66.89	52.68	53.22	45.77	66.04	65.9	49.81	50.73	68.74	62.35	50.16	61.19	53.22
5000	67.68	46.07	47.2	61.59	62.37	43.96	48.87	66.49	48.64	49.01	41.23	64.46	65.57	47.62	47.51	66.27	59.67	46.42	59.34	49.01
6300	67.14	44.61	48.54	60.28	61.95	42.05	46.89	63.59	46.54	46.45	40.43	64.6	63.5	46.02	46.02	65.43	57.1	43.39	56.21	46.45
8000	63.76	41.46	41.58	58.32	59.64	39.13	43.56	61.01	43.7	43.16	36.17	58.68	60.18	43.01	42.87	63.17	55.06	40.73	53.79	43.16
10000	61.31	37.21	37.75	55.88	57.17	35.89	40.05	57.92	40.24	39.32	32.43	56.25	57.05	39.2	38.97	60.11	51.36	37.28	49.72	39.32

Table A1.35 As measured sound pressure level data for the box source, Laboratory 4, second determination

freq band	ISO 3744 microphone position (see Table 1)																			
A-wt	82.6	67.9	68.1	75.5	76.5	64.4	67.7	79.5	67.2	68.7	64.8	77.8	78.1	66.4	66.7	81.2	73	66.2	72.7	68.7
50	71.26	65.36	63.71	67.21	63.64	61.05	64.06	64.53	64.49	59.64	64.74	62.56	62.35	61.97	64.27	65.8	63.92	67.61	68.06	59.64
63	69.71	64.86	64.02	64.51	71.78	63.73	66.51	67.1	64.84	61.97	64.89	63.8	63.71	63.99	65.26	66.49	65.19	65.38	62.77	61.97
80	78.57	71.14	72.25	75.23	74.46	71.4	72.58	76.01	73.66	72.06	72.46	76.46	74.95	71.12	72.22	76.46	73.28	71.52	74.55	72.06
100	77.37	69.85	70.67	74.6	74.2	71.68	72.6	76.36	72.48	71.92	71.05	74.34	74.34	71.12	71.57	76.86	74.41	72.15	74.81	71.92
125	71.17	63.85	64.49	66.46	67.28	63.5	63.1	67.57	63.4	62.51	64.82	67.64	68.01	62.18	62.89	69	66.11	63.87	65.47	62.51
160	68.48	59.9	61.22	64.79	65.1	60.72	60.06	64.65	61.95	60.49	62.44	65.31	65.36	59.92	61.19	67.24	63.69	59.45	63.19	60.49
200	69.43	58.77	59.64	64.67	64.72	59.9	58.65	65.22	57.95	59.97	61.05	65.97	65.07	57.2	59.01	67.9	63.05	57.9	63.08	59.97
250	71.61	60.63	60.42	66.13	66.18	59.64	60.23	65.92	60.37	61.57	61.31	67.71	68.01	60.16	60.23	68.67	64.25	57.92	63.78	61.57
315	71.82	60.84	60.18	65.4	65.8	57.97	59.19	64.06	58.65	58.32	57.9	65.33	66.32	60.68	60.91	68.91	61.01	57.38	61.57	58.32
400	68.79	60.21	61.29	63.85	63.4	53.76	54.96	58.11	54.51	54.3	56.35	66.58	65.03	57.95	59.85	65.38	57.78	51.74	57.27	54.3
500	70.6	60.49	61.59	62.79	63.57	54.09	56.58	62.37	54.56	57.57	54.77	68.53	67.54	57.95	58.94	65.97	58.91	54.68	59.41	57.57
630	71.68	59.17	59.88	61.45	61.15	51.6	56	65.57	54.28	58.94	53.06	66.23	67.14	54.63	55.78	63.29	60.68	55.31	61.31	58.94
800	72.88	57.81	57.64	61.48	62.04	50.14	57.01	63.92	55.29	55.6	53.41	65.38	66.51	53.55	53.15	65.85	61.05	55.2	61.97	55.6
1000	74.69	61.45	60.86	60.39	61.52	53.32	57.83	68.3	56.42	60.18	58.72	69.47	70.27	54.04	54.7	70.74	59.36	58.32	59.41	60.18
1250	73.99	58.79	59.74	65.1	65.59	54.7	59.38	71.07	58.23	60.28	54.47	67.17	68.3	54.42	55.1	72.11	62.96	56.68	63.12	60.28
1600	69.07	55.24	53.9	64.77	65.12	52.16	57.67	70.22	57.5	58.94	48.24	64.67	66.23	56.11	56.25	72.44	62.06	55.41	61.71	58.94
2000	65.31	50.49	50.28	66.77	68.58	54.26	56.61	69.54	57.05	57.88	48.21	60.79	62.84	57.48	57.27	71.05	62.82	55.57	62.11	57.88
2500	69.31	52.33	51.55	64.16	65.29	51.46	55.08	69.57	54.7	56.02	49.08	64.98	64.46	53.9	53.27	69.71	62.16	52.56	62.13	56.02
3150	73.16	53.34	52.99	65.85	66.91	51.95	54.23	67.36	54.26	54.49	50.68	69.5	68.16	53.6	52.75	71.07	61.45	52.33	60.7	54.49
4000	70.48	48.85	49.39	63.31	64.67	47.55	51.67	66.89	52.56	53.79	44.85	65.38	65.87	50.05	50.61	68.74	62.42	50.3	61.38	53.79
5000	67.8	45.65	46.17	61.71	62.3	44.38	48.85	66.27	48.54	49.48	40.26	63.5	65.59	47.84	47.27	66.2	59.74	46.5	59.52	49.48
6300	67.24	44.35	47.37	60.44	61.78	42.45	46.87	63.57	46.35	47.08	39.25	64.02	63.57	46.26	45.88	65.22	57.05	43.39	56.51	47.08
8000	63.9	41.23	40.94	58.49	59.45	39.6	43.44	60.84	43.56	44.1	35.54	58.21	60.04	43.16	42.64	63.17	55.03	40.66	54.14	44.1
10000	61.48	36.99	36.92	56.07	57.01	36.19	40	57.83	39.91	40.38	31.98	55.88	57.01	39.32	38.73	60.09	51.32	37.21	50.14	40.38

Table A1.36 As measured sound pressure level data for the box source, Laboratory 4, third determination

freq band	ISO 3744 microphone position (see Table 1)																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A-wt	82.5	67.9	68.3	75.5	76.5	64.2	67.5	79.5	67.2	68.6	64.7	77.6	78	66.5	66.8	81.2	72.8	66.3	72.5	68.6
50	66.41	65.36	64.44	63.69	62.79	62.63	61.62	63.12	62.63	60.72	62.53	65.07	64.37	70.91	61.92	62.84	61.29	67.14	66.56	60.72
63	67.07	64.86	68.2	65.26	64.74	63.29	64.84	63.85	64.74	62.16	62.21	65.8	64.56	63.64	64.46	64.93	62.46	63.92	66.7	62.16
80	78.22	71.14	72.86	75	73.49	71.33	72.88	75.96	71.94	71.57	71.02	76.86	74.22	71.33	72.11	76.62	73.09	71.75	74.41	71.57
100	76.83	69.85	70.3	74.74	74.48	71.49	72.48	76.65	72.11	71.99	70.37	74.5	74.01	70.74	71.24	76.74	74.06	72.11	74.86	71.99
125	69.75	63.85	64.67	66.3	67	63.69	62.89	67.66	62.91	62.49	64.49	67.52	67.66	62.93	62.16	68.74	65.19	63.19	65.31	62.49
160	67.47	59.9	59.38	64.49	64.46	60.58	60.02	65.17	60.18	60.63	62.02	65.47	64.96	61.73	59.9	67.14	63.17	63.19	63.22	60.63
200	68.77	58.77	58.47	64.53	64.6	60.06	57.97	65.5	57.71	59.57	60.91	66.16	64.84	58.32	57.95	67.8	62.68	59.52	63.03	59.57
250	71.54	60.63	60.44	66.13	66.11	59.34	59.27	66.04	60.23	61.45	61.31	67.73	67.78	60.75	60.11	68.77	64.02	57.27	63.8	61.45
315	71.82	60.84	60.75	65.29	65.78	58.02	58.51	63.76	58	58.44	58.07	64.98	66.01	61.38	60.68	68.98	60.65	57.85	61.33	58.44
400	68.67	60.21	60.96	63.62	63.12	53.57	54.26	58.18	52.99	53.39	56.47	66.53	64.86	58.18	59.57	65.4	57.48	51.76	57.01	53.39
500	70.46	60.49	61.73	62.72	63.55	54.02	55.86	62.32	54.33	57.31	54.35	68.53	67.5	57.97	58.7	65.9	58.61	54.98	59.08	57.31
630	71.45	59.17	59.97	61.36	60.86	51.03	55.76	65.54	54.14	58	52.84	66.25	66.86	54.98	55.48	63.36	60.54	55.55	61.22	58
800	72.95	57.81	57.85	61.36	61.41	49.91	56.7	64.16	54.89	56	53.41	65.29	66.23	54.26	53.17	65.85	61.05	55.08	61.81	56
1000	74.48	61.45	61.15	60.32	61.08	53.17	57.83	68.27	56.51	60.28	58.75	69.33	70.08	54	54.91	70.62	59.12	58.32	58.91	60.28
1250	74.11	58.79	59.76	65.12	65.22	54.37	59.5	71.09	58.4	59.99	54.59	66.96	68.01	54.56	55.31	72.06	62.91	56.68	62.91	59.99
1600	69.1	55.24	54.19	64.65	65.33	51.69	57.17	70.46	57.9	59.19	48.31	64.49	65.87	56.04	56.37	72.48	61.81	55.62	61.5	59.19
2000	65.22	50.49	50.96	66.65	68.67	54.14	56.35	69.57	57.67	58.16	48.38	60.79	62.68	57.41	57.52	71.19	62.44	55.62	61.83	58.16
2500	69.24	52.33	51.65	64.09	65.31	51.29	54.96	69.43	54.7	55.38	49.13	64.77	64.56	53.76	53.67	69.66	62.11	52.56	61.85	55.38
3150	73.02	53.34	53.15	65.9	66.93	51.83	54.14	67.4	54.4	54.33	50.66	69.33	68.25	53.57	53.34	71.09	61.41	52.35	60.39	54.33
4000	70.44	48.85	49.72	63.24	64.7	47.37	51.5	67.03	52.92	53.5	44.85	65.17	65.94	49.98	51.29	68.86	62.18	50.26	60.98	53.5
5000	67.83	45.65	46.68	61.64	62.37	44.05	48.71	66.56	48.92	49.03	40.43	63.24	65.59	47.79	48.12	66.34	59.55	46.54	59.12	49.03
6300	67.26	44.35	47.88	60.3	61.97	42.1	46.66	63.69	46.87	46.89	39.25	63.8	63.55	46.17	46.73	65.38	56.84	43.53	56	46.89
8000	63.9	41.23	41.32	58.4	59.64	39.2	43.41	61.05	43.96	43.72	35.47	57.95	60.32	43.16	43.67	63.22	54.94	40.85	53.55	43.72
10000	61.45	36.99	37.46	55.97	57.22	35.89	39.79	57.97	40.57	39.77	31.84	55.57	57.13	39.32	39.89	60.16	51.1	37.39	49.46	39.77