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Incorporating corrigendum October 2007

Acoustics — Procedure for the comparison of noise-emission data for machinery and equipment

ICS 17.140.20

National foreword

This British Standard is the UK implementation of EN ISO 11689:1996. It is identical with ISO 11689:1996, incorporating corrigendum October 2007.

The start and finish of text introduced or altered by corrigendum is indicated in the text by tags. Text altered by ISO corrigendum October 2007 is indicated in the text by [AC1⟩ ⟨AC1].

The UK participation in its preparation was entrusted by Technical Committee EH/1, Acoustics, to Subcommittee EH/1/4, Machinery noise.

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Acoustique - Procédure de comparaison des données d'émission sonore des machines et équipements (ISO 11689:1996)

Akustik - Systematische Zusammenstellung und Vergleich von Geräuschemissionsdaten für Maschinen und Anlagen (ISO 11689:1996)

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Foreword

The text of the International Standard ISO 11689:1996 has been prepared by Technical Committee ISO/TC 43 "Acoustics" in collaboration with Technical Committee CEN/TC 211 "Acoustics", the secretariat of which is held by DS.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 1997, and conflicting national standards shall be withdrawn at the latest by June 1997.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Endorsement notice

The text of the International Standard ISO 11689:1996 was approved by CEN as a European Standard without any modification.

Contents

Descriptors: acoustics, machinery, equipment, noise (sound), engine noise, data, collecting, comparison.

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 11689 was prepared by Technical Committee ISO/TC 43, *Acoustics*, Subcommittee SC 1, *Noise*, on request by CEN/TC 211, *Acoustics*.

Annexes A to D of this International Standard are for information only.

Introduction

National and international regulations increasingly require the production and use of low-noise machinery and equipment. This implies that manufacturers, users of machinery and equipment and authorities are aware of the noise emission of a particular product in relation to the noise emission of the relevant machine family. This will only be possible if reliable information on the actual noise emission is available or can be determined.

Based on this information, any index of noise-control performance can be determined for a well-defined family, type or group of machinery or equipment available on the market at a stated time.

The comparison and evaluation of noise-emission data are of use to

a) a designer requiring information about noise levels for a particular family, for example when specifying the desired properties of a new concept;

b) a user and/or buyer of machinery or equipment belonging to a specific family, who wishes to compare similar machinery or equipment available on the market with regard to noise emission;

c) working groups preparing machinery safety standards, noise test codes and/or noise guidelines relating to a particular family;

d) authorities in charge of legislation, labour supervision and inspection, health and safety at work;

e) manufacturers and potential users of noise-emission data bases;

f) consultants in acoustics using appropriate techniques for performing a first evaluation of the noise level on a site.

In addition to knowledge about noise control at source by design, the evaluation procedure requires particular knowledge of the machine group in question.

Collecting noise-emission data and editing clusters of noise-emission data are the responsibility of a committee of the parties involved (e.g. manufacturers, authorities or consumer organisations).

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Acoustics — Procedure for the comparison of noise-emission data for machinery and equipment

1 Scope

This International Standard specifies a method for establishing the noise-control performance for a family, type, group or sub-group of machinery or equipment on the basis of noise-emission data. It is, in principle, applicable to any kind of machinery or equipment for which a noise test code exists or comparable noise-emission data are available.

NOTE 1 The general procedure described in this International Standard is, in principle, applicable to other physical agents (e.g. vibration).

This International Standard specifies methods and requirements for comparison of noise-emission data so that they can be used for the determination of noise-control performance.

The methods presented allow evaluation of the noise emission of individual machines or of a single type of machine within a machine group, i.e. allow a comparison of the acoustical aspects of machines with comparable non-acoustical data and fields of application.

Annex B gives examples of how the evaluation of collected noise-emission data for a machine group can be carried out.

2 Normative reference

The following standard contains provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the edition indicated was valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent edition of the standard indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 12001:1996, *Acoustics — Noise emitted by machinery and equipment — Rules for the drafting and presentation of a noise test code.*

3 Definitions

For the purposes of this International Standard, the definitions given in ISO 12001 and the following definitions apply.

3.1 family of machinery or equipment: Machinery or equipment of similar design or type, intended to perform the same functions.

3.2 measured noise-emission value: Value of the time-averaged A-weighted sound power level L_{WA}, or the A-weighted emission sound pressure level L_{pA}, or the C-weighted peak emission sound pressure level $L_{pC,peak}$ determined from measurements.

3.3 declared noise-emission value: Value of the declared A-weighted sound power level L_{WAd}, the declared A-weighted emission sound pressure level L_{pAd}, or the declared C-weighted peak emission sound pressure level, $L_{pC,peak,d}$.

3.4 characteristic machine parameter: Non-acoustic quantity which characterizes a particular group of machines.

NOTE 2 Its value varies between the individual machines within the group (e.g. power, speed, load, dimension).

3.5 noise-control performance: Performance determined by the noise emission of all machines in a given set. (See classification in clause 4.) L-lines can be used for its description (see 3.7).

3.6 cumulative frequency of noise-emission values: Number of observations in a set, which have values equal to or less than a given value. (See clause 7.)

3.7 L-lines: Lines which are parallel to the regression line (see annex A) and below which a specified percentage of the noise-emission values lies (see clause 7).

4 Machine classification

Machines shall be classified according to their application. A standardized classification shall be used, when available.

Machines shall be classified into families and groups, based on the following criterion:

— the various families and groups of machines shall be defined precisely, so that it is possible to assign a machine unambiguously to a single family and a single group.

EXAMPLE

Woodworking machines

a) Machine families belonging to woodworking machines, such as

— planing machines,

— circular sawing machines,

— moulding machines,

— bandsawing machines.

b) Groups of circular sawing machines, such as

— circular saw benches,

— circular sawing machines for building sites.

c) Sub-groups for different ranges of diameters, such as

— up to 350 mm,

— 350 mm to 500 mm.

5 Noise-emission data

5.1 Noise-emission quantities

The following types of noise-emission quantities are distinguished.

a) Principal noise-emission quantities:

— A-weighted sound power level L_{WA};

— A-weighted emission sound pressure level L_{pA} at the work station (operator position) or at other specified positions;

— C-weighted peak emission sound pressure level, $L_{pC,peak}$.

b) Additional noise-emission quantities:

— surface emission sound pressure level $\overline{L}_{pAf}$ at a distance d from the machine (sound pressure level averaged on an energy basis over a measurement surface at a distance d from the sound source);

— other quantities laid down in International Standards and regulations.

c) Additional noise-emission information:

— emission sound pressure spectra (e.g. in octave bands or one-third-octave bands) at selected measuring points;

— sound power spectra (e.g. in octave bands or one-third-octave bands);

— impulsiveness;

— directivity index.

NOTE 3 Definitions of these quantities are given in the ISO 3740 series, ISO 4871 and the ISO 11200 series.

5.2 Measurement methods

Noise-emission data shall be determined using standardized measurement methods such as machine-specific noise test codes or, if comparability can be ensured by defining all relevant parameters, by using basic noise-emission standards (e.g. the ISO 3740 series, ISO 9614-1 and ISO 11200 series).

The following additional information shall be provided when applying the basic standards:

— the classification of the object being measured;

— the measurement method and its grade of accuracy;

— operating conditions under which noise-emission measurements have been carried out.

If, however, a measuring procedure is laid down as mandatory in national or international legal provisions, then the measurements shall be carried out in accordance with that procedure.

5.3 Representativeness of data

Representative noise-emission data are the basis for the description of the noise-control performance.

The crucial factor for a balanced data stock is not the quantity, but the representativeness of the data. Normally 100 % market coverage is not possible for a group of machines, therefore, noise-emission data are considered as representative according to this International Standard if at least 50 % of the manufacturers on the market and 50 % of models sold in the group are covered. If this criterion cannot be fulfilled, a committee of the interested parties shall decide whether the data are to be regarded as representative. The market may be a national one, a market which includes several countries, or an international market. The machines covered shall be offered on such a market at the time of the survey. The test shall be carried out on a machine which is new and, if necessary, run-in. If the data stock is not representative in accordance with the requirements of this International Standard, this fact shall be indicated clearly and the percentage of the machines covered shall be stated.

During the collection of noise-emission data, the parameters identifying the machine and its manufacturer, the period in which the emission values have been determined, and all other elements which can be useful for the comparison (e.g. the percentage of market coverage, technical means used to reduce noise at the source, cost thereof, etc.) shall be recorded.

5.4 Types of noise-emission values

The noise-emission values are the values of the quantities specified in the specific noise test code (see 5.2).

5.4.1 Individual values for single machines

The individual values are obtained at a single machine. The collection of individual values is especially suitable for individually manufactured machines and for small series of machines.

5.4.2 Mean values for batches of machines

The noise emission from each model of machine is represented by the arithmetic mean of the individual values of the machines in a batch.

The arithmetic mean $\overline{L}$ of N individual values L_i is given by the following equation:

$$\overline{L} = \frac{1}{N} \sum_{i=1}^{N} L_i$$

The arithmetic mean of the random individual values may be presented together with the double standard deviation, $\pm 2s_{\text{prod}}$ or $\pm 2s_{\text{tot}}$ (for more information see ISO 4871, ISO 5725-1 and ISO 7574-1), as determined from the production or total scatter. The presentation of the standard deviation of each mean value (average of the same model of a given manufacturer) is only practicable if the number of different models of machine offered and recorded is not too great. The collection of mean values is especially suitable for machines produced in large numbers.

NOTE 4 The standard deviation s characterizes the distribution of the values L_i around the mean value. Approximately 68 % of all measured values will lie between ($\overline{L} - s$) and ($\overline{L} + s$) and approximately 95 % between ($\overline{L} - 2s$) and ($\overline{L} + 2s$); s is calculated according to the following equation:

$$s = \sqrt{\frac{1}{N-1} \sum_{i=1}^{N} \left(L_i - \overline{L}\right)^2}$$

6 Presentation of noise-emission values

6.1 Noise-emission values shall be presented on the basis of the machine classification. In particular, the influence of the characteristic machine parameters (e.g. power, speed, load, dimension) on noise emission has to be established.

6.2 The presentation shall be given in tabular form (machine data, noise-emission data) and/or graphs (see annex C). A table shall contain noise-emission data, technical data and further characteristic data.

6.3 For the graphical presentation, the following requirements shall be met.

a) If the characteristic machine parameter has a negligible influence on the noise emission, noise-emission data shall be presented in one or more of the following forms:

   1) to indicate the range in which all considered noise-emission data lie, lines may be drawn parallel to the regression line through those points which deviate the most from it;

   2) indication of the range within which all considered noise-emission values lie;

3) indication of the range (greatest and smallest values) as well as the mean value;

4) indication of the mean value and ± 2*s*.

b) The scatter of noise emission values shall be shown on appropriate histograms or diagrams.

c) If, from the noise-emission data collected, a clear dependence can be established between noise emission values and one or more characteristic machine parameters, this shall be presented in the form of one or more noise-emission graphs (see figure 1 and figures B.1 to B.3).

NOTES

5 The characteristic parameters retained should preferably be chosen among those which result in a better correlation (see annex A) and which are related to a criterion for the selection of the machine(s).

6 The characteristic machine parameter(s) can be given in a noise test code or in the noise clause of a safety standard.

d) If both declared and measured values are available, they shall not be drawn on the same graph.

6.4 The presentation of noise-emission data shall contain at least the cluster of noise-emission values with the calculated regression line (see annex A). If a single linear regression line does not clearly indicate the dependence of the noise-emission values on the characteristic machine parameter, the covered range of a characteristic machine parameter shall be divided into sub-ranges in which a linear regression or any other applicable regression analysis can be carried out (see figures B.1 and B.3).

6.5 Each table or graph of data shall be dated by the year of collection of the data, and the reference to the noise test code used shall be given.

NOTES

7 Any other elements that might be useful for the evaluation of the data can be given.

8 If so agreed by the parties involved, names of machines and manufacturers should be given. Otherwise, tables and graphs should be anonymous.

7 Evaluation of noise-emission data

7.1 General

For evaluating noise-emission data, use the L-lines. Supplementary information of noise-controlling design principles, noise-control measures, etc. may also be given.

If the noise-emission values for different models of a certain machine group are determined under fully comparable conditions, then, taking due account of the measurement uncertainty, the machine within this machine group with a lower emission value has a higher noise-control performance.

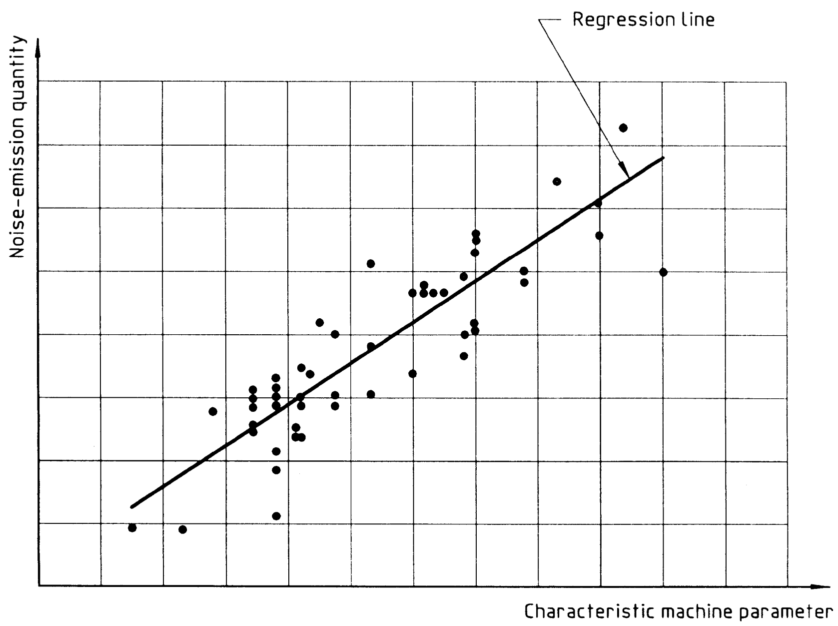


Figure 1 — Presentation of noise-emission values as a function of a characteristic machine parameter

Generally, an effective evaluation of noise-emission data can be made by analysing it in graphical form using two lines L_1 and L_2 parallel to the regression line. For evaluation of the noise-emission data it is recommended to place

line L_1 at x = 70 % ... 95 %, and

line L_2 at y = 10 % ... 30 %

of the cumulative frequency of noise-emission values, in steps of at least 5 %.

NOTE 9 The percentages of cumulative frequency for L_1 and L_2 may be given in a specific subclause of the relevant safety standard.

The distance between L_1 and L_2 should be at least 3 dB, otherwise the classification given in 7.2 to 7.4 is less significant.

7.2 High noise-emission values

Noise-emission values above L_1 (see figure 2) are normally indicative of those machines having a low noise-control performance. L_1 shall be given by a high value of the cumulative frequency of the noise-emission values (x %, see annex B).

7.3 Average noise-emission values

The range between L_1 and L_2 (see figure 2) covers those machines having an average noise-control performance.

7.4 Low noise-emission values

Noise-emission values below L_2 (see figure 2) are normally indicative of those machines having a high noise-control performance. L_2 shall be given by a low value of the cumulative frequency of the noise-emission data (y %, see annex B).

7.5 Further noise-emission range

For some groups of machines or equipment, it may be practical to set a further emission range by establishing a line L_3 below L_2, parallel to the regression line. Noise-emission values below L_3 indicate those machines for which a superior noise-control performance has been attained (with increased effort). L_2 and L_3 shall be at least 3 dB apart, otherwise L_3 shall not be drawn.

Lines L_1 and L_2 (and L_3 if appropriate) shall be accompanied by the indication of the relative cumulative frequency percentage [e.g. $L_1(x$ %), $L_2(y$ %), $L_3(z$ %)].

In order to supplement the information gathered regarding the noise-control performance of a given group of machinery or equipment, it is useful to indicate the noise-control measures used by manufacturers, in addition to the noise-emission data.

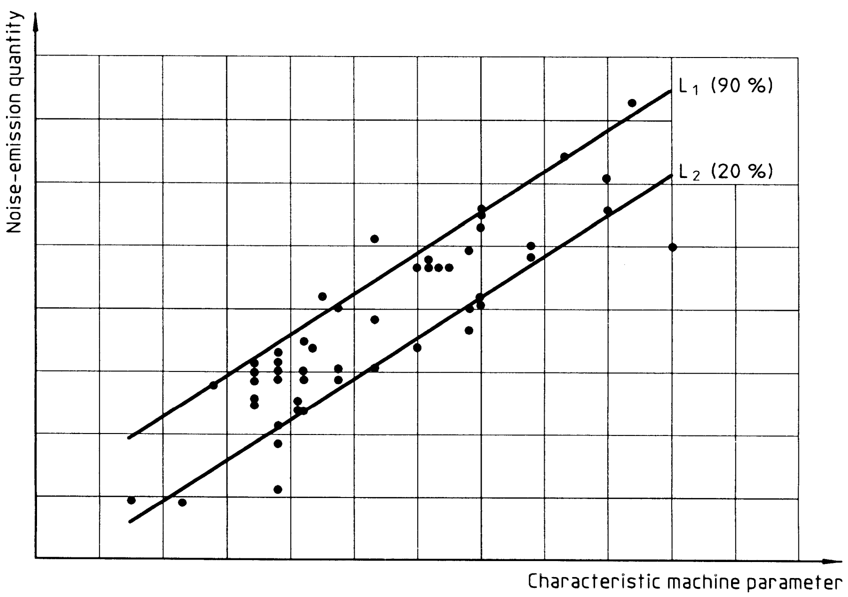


Figure 2 — Evaluation of noise-emission data and determination of noise-control performance

8 Steps to be followed when determining noise-control performance

The following steps shall be followed when determining the noise-control performance of a given group of machinery or equipment.

a) Look for a standardized noise-emission measurement method for the group of machinery or equipment for which establishment of the noise-control performance is desired (see 5.2).

b) Organize the collection of noise-emission data and corresponding machinery parameters from the manufacturers of the machinery or equipment concerned.

c) Analyse the data collected and use only those which have been obtained using established test codes and are comparable; discard the rest.

d) Quantify the percentage of the market covered by the collected data retained for the group of machinery or equipment concerned, and ensure they are representative (see 5.3).

e) Identify relevant characteristic machine parameter(s) to which noise emission is correlated (normally to be found in the noise test code).

f) Prepare noise-emission graphs (clusters of noise-emission data plotted against a machine characteristic parameter). Determine sub-ranges of values of the machine characteristic parameter, if necessary. Determine the regression line(s) for each cluster (see clause 6).

g) Choose the cumulative frequency of noise-emission data to be used for determining lines L_1 and L_2 and determine whether or not it is possible and relevant to draw line L_3 (see clause 7).

The implementation of the above procedure for determining noise-control performance is a specific task that can be performed by any of the parties involved (e.g. manufacturers, users, authorities, health and safety experts, acousticians).

9 Information to be recorded

a) Machine data shall include

   1) the classification of the machine in accordance with clause 4;

   2) technical data;

   3) description of the characteristic machine parameter(s) (represented by the abscissa in figure 2);

   4) number of machines tested; percentage of the market (representative nature of data);

   5) operating conditions of the machine;

   6) time period over which noise-emission data were collected and by whom;

   7) data identifying the machine.

b) Acoustical data shall include

   1) noise-emission quantity;

   2) noise test code applied;

   3) noise-emission data (in a list or in graphical form) and their origin, as well as information on noise-control measures, if available;

   4) further details on operating conditions of the machine if not in accordance with the noise test code.

c) Evaluation data shall include

   1) graphs showing $L_1(x\ \%)$ and $L_2(y\ \%)$ [and $L_3(z\ \%)$ if appropriate];

   2) the values of x and y (and z, if applicable).

10 Information to be reported

At least the following items from clause 9 shall be reported: a1), a3), a4), a5), a6), b1), b2), b3), c1) and c2).

Annex C gives an example of the presentation of noise-emission data in accordance with this International Standard. Copies of this annex may be used for the report.

Annex A
(informative)

Calculation of a linear regression

A.1 General

The calculation method laid out in this annex for determining the best linear fit for a set of pairs of values (x_i; y_i) is commonly used. It is based upon the least-squares method. Computer software for this kind of analysis of data is commonly available.

For the purposes of this International Standard, only linear regression is considered. Should the problem arise that the data seem to be better modelled using curvilinear regression, piecewise linear regressions for subsets of the data should be carried out.

NOTE 10 The method given here is a general (linear) regression method and may also be suited for other problems.

A.2 Definitions and symbols

For the purposes of this annex, the following definitions and terms are used.

A.2.1 pair of data: (x_i; y_i): Value of the characteristic machine parameter x of a machine labelled i (see 3.4) and the value of the noise emission quantity y which was determined for this machine.

NOTE 11 y may be an individual value for a single machine or a mean value for a batch of machines (see 5.4.1 and 5.4.2).

A.2.2 linear function: An ideal linear relationship between x and y, for which all pairs of data can be described by

$$y_i = a\,x_i + b$$

where

a is the slope of the line;

b is the value of y for $x = 0$, called the intercept.

A.2.3 regression line: Best fit of a linear function to an ensemble of pairs of data for which a linear relationship is assumed but which, due to measurement uncertainty, scatter around a line.

According to common statistics textbooks (see e.g. annex D), the values of a and b for the regression line for N pairs of data can be calculated as follows:

$$a = \frac{N\sum_{i=1}^{N} x_i y_i - \sum_{i=1}^{N} x_i \sum_{i=1}^{N} y_i}{N\sum_{i=1}^{N} x_i^2 - \left(\sum_{i=1}^{N} x_i\right)^2}$$

$$b = \frac{\sum_{i=1}^{N} y_i - a\sum_{i=1}^{N} x_i}{N}$$

A.2.4 correlation coefficient, r**:** Quantity indicating the extent to which there is a linear relationship between the values x_i and y_i; r is calculated from

[AC1)

$$r = \frac{\sum_{i=1}^{N} x_i y_i - \frac{1}{N}\left(\sum_{i=1}^{N} x_i\right)\left(\sum_{i=1}^{N} y_i\right)}{\sqrt{\left[\sum_{i=1}^{N} x_i^2 - \frac{1}{N}\left(\sum_{i=1}^{N} x_i\right)^2\right]\left[\sum_{i=1}^{N} y_i^2 - \frac{1}{N}\left(\sum_{i=1}^{N} y_i\right)^2\right]}}$$

(AC1]

The data are completely linear for $r = 1$, and there is no correlation for $r = 0$.

A.3 Example of the calculation of a regression line

In this example let x be the power rating of a fictitious machine, in kilowatts, with y being the A-weighted sound power level L_{WA}, in decibels. Table A.1 presents the pairs of data and the products and sums needed for the regression analysis.

From these seven pairs of data, the value of the slope is calculated as

$$a = \frac{N\sum_{i=1}^{N} x_i y_i - \sum_{i=1}^{N} x_i \sum_{i=1}^{N} y_i}{N\sum_{i=1}^{N} x_i^2 - \left(\sum_{i=1}^{N} x_i\right)^2}$$

$$= \frac{7 \times 11\ 775 - 103 \times 798}{7 \times 1\ 593 - 103^2} = 0{,}426$$

and the intercept is

$$b = \frac{\sum_{i=1}^{N} y_i - a \sum_{i=1}^{N} x_i}{N}$$

$$= \frac{798 \times 1\ 593 - 103 \times 11\ 775}{7 \times 1\ 593 - 103^2} = 107{,}729$$

The data can thus be approximated by a linear function with

$$y = 107{,}729 + 0{,}426\,x$$

The correlation coefficient is

[AC1⟩ $r = 0{,}709$ ⟨AC1]

For a presentation of this example, refer to figure A.1.

Table A.1 — Fictitious noise-emission data

i	x_i	y_i	x_i^2	y_i^2	$x_i y_i$
1	13	112	169	12 544	1 456
2	17	117	289	13 689	1 989
3	10	111	100	[AC1⟩ 12 321 ⟨AC1]	1 110
4	17	113	289	12 769	1 921
5	20	116	400	13 456	2 320
6	11	114	121	12 996	1 254
7	15	115	225	13 225	1 725
Sum	103	798	1 593	[AC1⟩ 91 000 ⟨AC1]	11 775

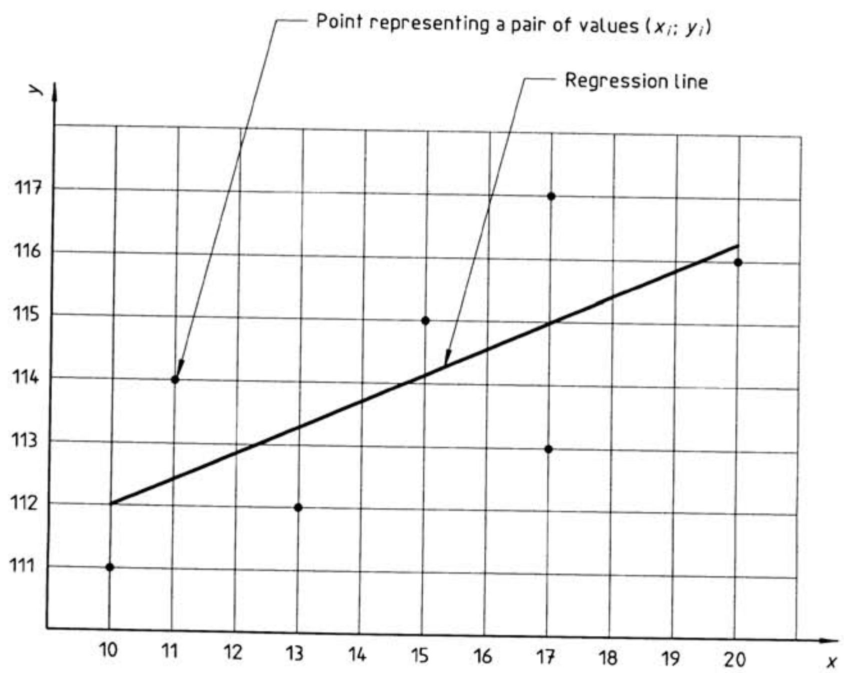
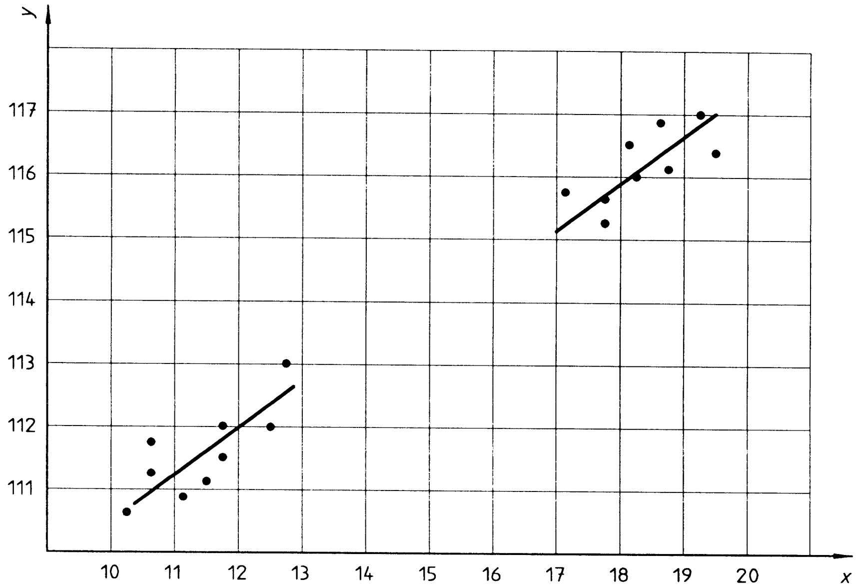


Figure A.1 — Example of the linear regression for the data of table A.1

A.4 Validity of the results of a regression analysis

Generally, the regression analysis becomes more reliable with an increasing number of pairs of data. From the statistical point of view, the number of pairs of data in the example in A.3 (seven) is a rather small number of pairs to analyse.

Extrapolation of the regression line beyond the range of the data is likely to produce misleading results. The same can be said about interpolation of a regression between two obviously separate clusters of pairs of data (see figure A.2).



NOTE — Interpolation between the clusters is likely to be misleading.

Figure A.2 — Example of separate clusters of pairs of data

Annex B
(informative)

Examples of evaluation of noise-emission data

Three examples of the presentation of noise-emission data featuring the noise-control performance of a specific group of machinery are given below.

Measured data (e.g. sound power levels) exist for quite different groups of machines (examples 1, 2 and 3). These data are presented in figures B.1, B.2 and B.3 as a function of a characteristic machine parameter. Each machine from a given manufacturer is represented by an averaged value.

Noise-emission data are evaluated for each group of machines (examples 1, 2 and 3). The dependence of noise-emission values on characteristic machine parameters (e.g. power), suitable grouping and possible technical measures and designs leading to a lower noise emission are taken into consideration. The average dependence of noise-emission values upon a characteristic machine parameter is calculated according to annex A and represented by the regression line; L-lines are drawn parallel to the regression line.

For many cases, placing the line L_1 at 85 % cumulative frequency of the noise-emission values and the line L_2 at 15 % of the cumulative frequency of noise-emission values should be a good choice (see clause 7).

The evaluation requires reasonable knowledge concerning groups of machines and the possible or applied technology and noise-control measures. It can be done by a committee dealing with standardization for the specific group of machinery.

EXAMPLE 1

In this example (see figure B.1) there is no clear correlation between the value of the noise-emission quantity and that of the characteristic machine parameter. Because above an intermediate value of the characteristic machine parameter significantly higher noise-emission values occur, it is useful to divide the data into two sub-groups.

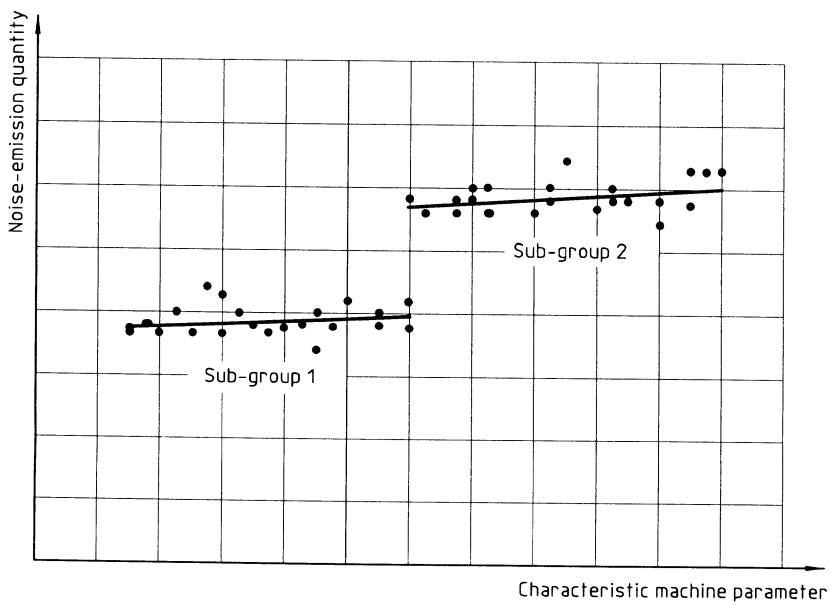


Figure B.1 — Formation of sub-groups

EXAMPLE 2

In this example, there is a clear dependence of the value of the noise-emission quantity upon that of the characteristic machine parameter (see figure B.2). The L_1-line is drawn at 90 %. Most of the machines fall below it if simple technical measures have been applied. The L_2-line is drawn at 20 %. Using available noise-control measures, noise emission can be lower than indicated by the L_2-line.

NOTE 12 The characteristic machine parameter may be a logarithmic quantity. The choice of a logarithmic scale for the characteristic machine parameter may be helpful to establish a linear relationship between the noise-emission quantity and the characteristic machine parameter.

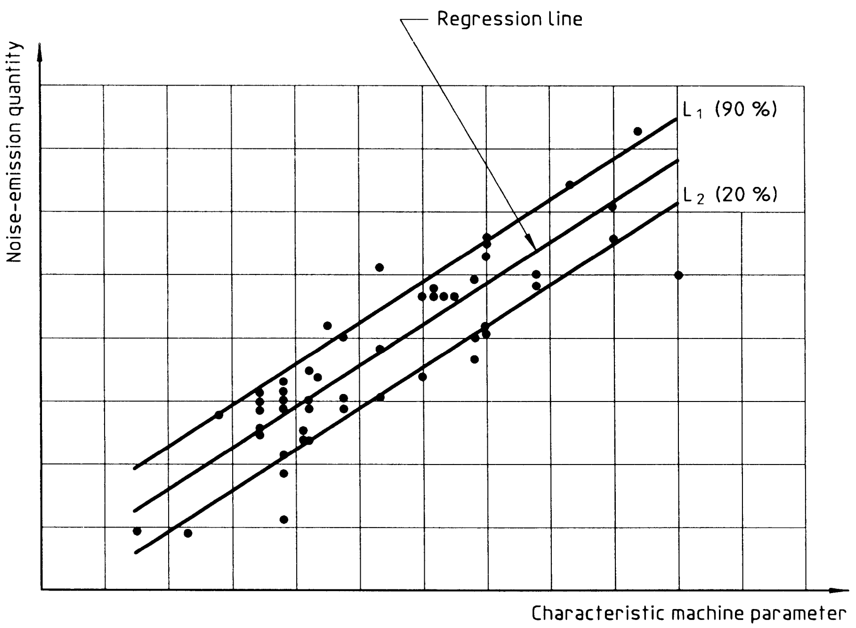


Figure B.2 — Data with a clear linear relationship between lines L_1 and L_2

EXAMPLE 3

A clear correlation between the value of the noise-emission quantity and that of the characteristic machine parameter can only be found for low values of the latter (see figure B.3). For higher values, the value of the noise-emission quantity is almost constant even when the value of the characteristic machine parameter varies considerably. A linear regression over the whole range of values of the characteristic machine parameter therefore does not make sense. Division into two sub-groups is appropriate. Within the two sub-groups, linear regressions can be carried out.

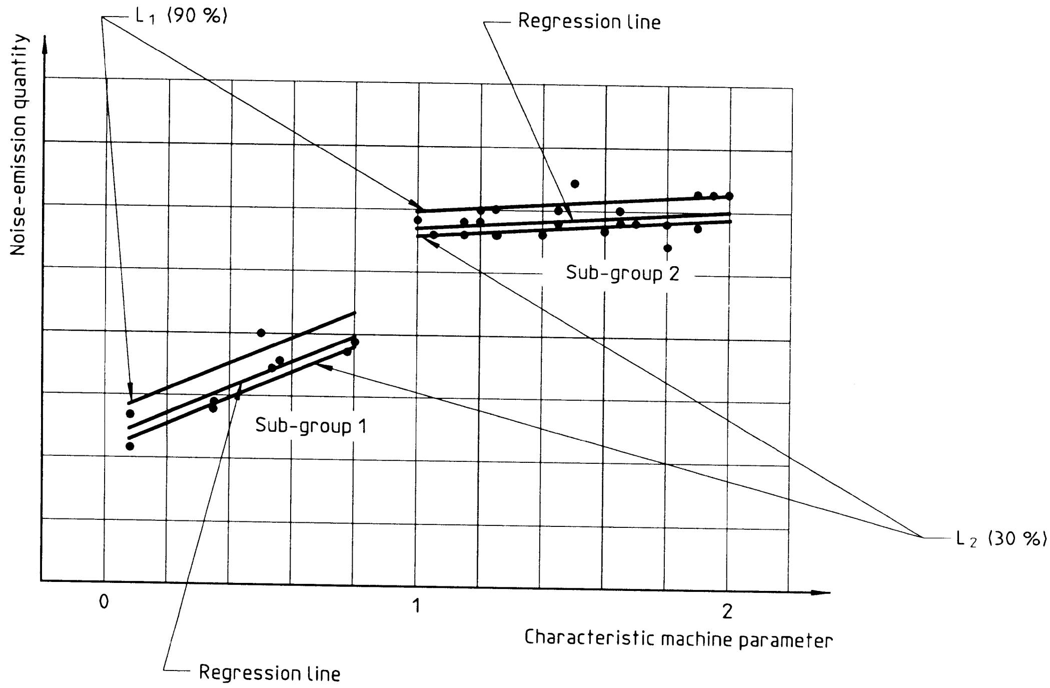


Figure B.3 — Example of two sub-groups with different behaviour

Annex C
(informative)

Example of the presentation of noise-emission data in accordance with this International Standard (form sheet to be copied)

Noise-control performance of ...... (machine)

Machine classification: ....

Number of machines: .....

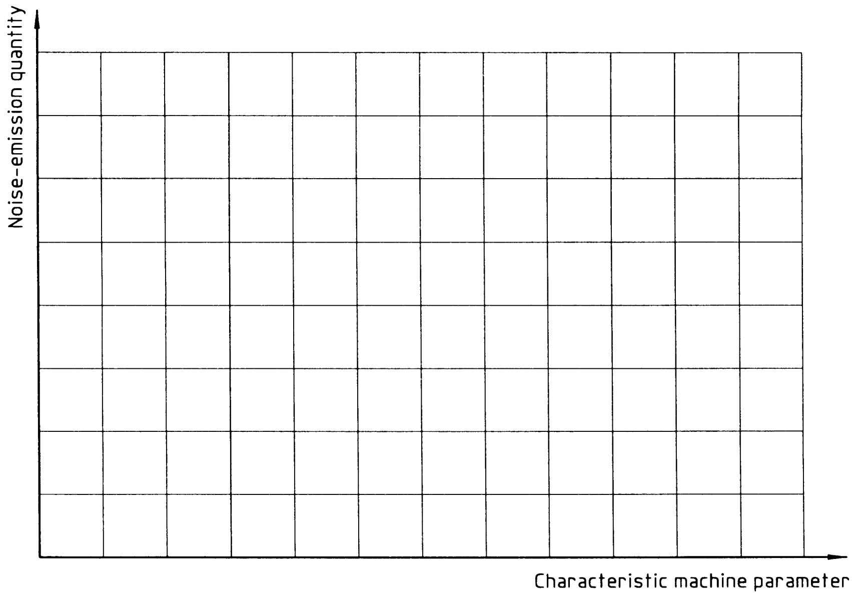
Market coverage:
— manufacturer: ..... %
— models: ..... %

Percentages of cumulative frequency of noise emission values:

L_1: ..... %
L_2: ..... %
L_3: ..... %

Collection period of the data: ....

Data collected by: ....



Noise-emission quantity

☐ sound power level, L_{WA}
☐ sound pressure level, L_{pA}, $L_{pC,peak}$
☐ other, namely: ....

Characteristic machine parameter

....
....

Noise test code (either complete standard or clause in a safety standard)

☐ ISO ....
☐ other, namely ....

Operating conditions of machine

☐ see ISO ....
☐ other, namely ....

Type of emission values

☐ individual values for single machines
☐ mean values for batches of machines
☐ declared values
☐ other, namely..

Annex D
(informative)

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