BRITISH STANDARD

BS EN 415-9:2009

Safety of packaging machines

Part 9: Noise measurement methods for packaging machines, packaging lines and associated equipment, grade of accuracy 2 and 3

ICS 17.140.20; 55.200

National foreword

This British Standard is the UK implementation of EN 415-9:2009.

The UK participation in its preparation was entrusted to Technical Committee MCE/3/3, Packaging machines.

A list of organizations represented on this committee 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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This British Standard was published under the authority of the Standards Policy and Strategy Committee on 30 September 2009

ISBN 978 0 580 55661 6

Amendments/corrigenda issued since publication

Date	Comments

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 415-9

August 2009

ICS 17.140.20; 55.200

English Version

Safety of packaging machines - Part 9: Noise measurement methods for packaging machines, packaging lines and associated equipment, grade of accuracy 2 and 3

Sécurité des machines d'emballage - Partie 9 : Codes d'essai bruit pour machines d'emballage, ligne d'emballage et équipements associés - Méthode de catégorie 2 et 3

Sicherheit von Verpackungsmaschinen - Teil 9: Verfahren zur Geräuschmessung bei Verpackungsmaschinen, Verpackungslinien und Hilfseinrichtungen - Genauigkeitsklassen 2 und 3

This European Standard was approved by CEN on 10 July 2009.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: Avenue Marnix 17, B-1000 Brussels

Ref. No. EN 415-9:2009: E

Contents

Page

Foreword

This document (EN 415-9:2009) has been prepared by Technical Committee CEN/TC 146 “Packaging machines safety”, the secretariat of which is held by UNI.

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of an identical text or by endorsement, at the latest by February 2010, and conflicting national standards shall be withdrawn at the latest by February 2010.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

The standard EN 415 consists of the following parts:

— *Packaging machines safety – Part 1: Terminology and classification of packaging machines and associated equipment*

— *Packaging machines safety – Part 2: Pre-formed rigid container packaging machines*

— *Safety of packaging machines – Part 3: Form, fill and seal machines*

— *Safety of packaging machines – Part 4: Palletisers and depalletisers*

— *Safety of packaging machines – Part 5: Wrapping machines*

— *Safety of packaging machines – Part 6: Pallet wrapping machines*

— *Safety of packaging machines – Part 7: Group and secondary packaging machines*

— *Safety of packaging machines – Part 8: Strapping machines*

— *Safety of packaging machines – Part 9: Noise measurement methods for packaging machines, packaging lines and associated equipment, grade of accuracy 2 and 3*.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

This standard specifies all the information necessary to carry out efficiently and under defined conditions the determination, information and verification of airborne noise emission from packaging machine covered by EN 415-1.

This measurement method specifies procedures for the determination of emission sound pressure levels at work station, at other specified positions and the sound power level on the basis of both the sound pressure level method and the sound intensity method. It also specifies installation and operating conditions.

This standard applies to machines covered by EN 415-1 as well as for any other packaging machine which are not covered by any other specific noise test code as well as for machines being part of packaging line. In such cases, all information relating to the assembly, installation and to the operating conditions as well as the arrangement of the work station shall be recorded and reported in the test report.

Noise emission characteristics include the following data:

— emission sound pressure level at work station and at other specified positions;

— sound power emitted by machine.

Both can be used:

— to determine the noise emitted by machine;

— to inform on the noise emitted by the machine;

— to verify the noise emitted by the machine.

Noise emission values permit comparison of packaging machines on the market.

The use of this standard ensures the reproducibility of the determination of the characteristic noise emissions values within specific limits which will be determined by the grade of accuracy of the noise emission measuring method used.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 415-1:2000, *Packaging machines safety – Part 1: Terminology and classification of packaging machines and associated equipment*

EN ISO 3740:2000, *Acoustics – Determination of sound power levels of noise sources – Guidelines for the use of basic standards (ISO 3740:2000)*

EN ISO 3744:1995, *Acoustics – Determination of sound power levels of noise sources using sound pressure – Engineering method in an essentially free field over a reflecting plane (ISO 3744:1994)*

EN ISO 3746:1995, *Acoustics – Determination of sound power levels of noise sources using sound pressure – Survey method using an enveloping measurement surface over a reflecting plane (ISO 3746:1995)*

EN ISO 3747:2000, *Acoustics – Determination of sound power levels of noise sources using sound pressure – Comparison method for use in situ (ISO 3747:2000)*

EN ISO 4871:1996, *Acoustics – Declaration and verification of noise emission values of machinery and equipment (ISO 4871:1996)*

EN ISO 9614-2:1996, *Acoustics – Determination of sound-power levels of noise sources using sound intensity – Part 2: Measurement by scanning (ISO 9614-2:1996)*

EN ISO 11200:1995, *Acoustics – Noise emitted by machinery and equipment – Guidelines for the use of basic standards for the determination of emission sound pressure levels at a work station and other specified positions (ISO 11200:1995)*

EN ISO 11201:1995, *Acoustics – Noise emitted by machinery and equipment – Measurement of emission sound pressure levels at a work station and at other specified positions – Engineering method in an essentially free field over a reflecting plane (ISO 11201:1995)*

EN ISO 11202:1995, *Acoustics – Noise emitted by machinery and equipment – Measurement of emission sound pressure levels at a work station and at other specified positions – Survey method in situ (ISO 11202:1995)*

EN ISO 11203:1995, *Acoustics – Noise emitted by machinery and equipment – Determination of emission sound pressure levels at a work station and at other specified positions from the sound power level (ISO 11203:1995)*

EN ISO 11204:1995, *Acoustics – Noise emitted by machinery and equipment – Measurement of emission sound pressure levels at a work station and at other specified positions – Method requiring environmental corrections (ISO 11204:1995)*

EN ISO 12001:1996, *Acoustics – Noise emitted by machinery and equipment – Rules for the drafting and presentation of a noise test code (ISO 12001:1996)*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply in addition to these given in EN ISO 12001:1996 and the basic standards (B-standards) for the determination of emission sound pressure levels at work station and other specified positions: EN ISO 11200:1995, EN ISO 11201:1995, EN ISO 11202:1995, EN ISO 11203:1995, EN ISO 11204:1995; and in the basic standards for the determination of sound power levels: EN ISO 3740:2000, EN ISO 3744:1995, EN ISO 3746:1995, EN ISO 9614-2:1996.

3.1
very large machine
machine or packaging line where the greatest linear dimension exceeds 7 meters (Figure C.6, Annex C of EN ISO 3744:1995 or Figure C.6, Annex C of EN ISO 3746:1995)

NOTE See Figure 1.

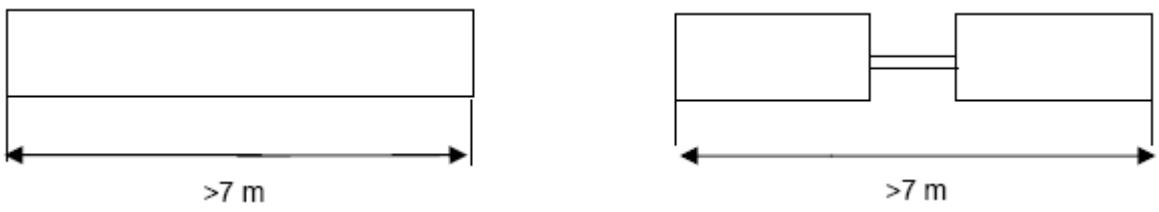

Figure 1 — Very large machines

4 Description of machine under test

The machines specified in this standard are listed in EN 415-1, and, for machines not listed, the manufacturer shall describe them in the test report.

The packaging machine described by Annex D (informative) of this document includes any equipment, electric cabinet and optional devices, delivered with the machines, which contribute to the overall noise emission.

5 Determination of the emission sound pressure level at work station

5.1 Sound pressure level measurement at work station

The A-weighted emission sound pressure level at the workstation L_{pA} shall be determined in compliance with EN ISO 11201, EN ISO 11202, EN ISO 11203 or EN ISO 11204.

The appropriate standard shall be selected by using Annex A (normative).

The positions of the work stations and of other specified positions shall be defined by the manufacturer in compliance with Annex D (informative).

In all cases the microphone shall be located directly above the reference point on the ground plane on which the operator normally stands, at a distance of 1 m from the machine, at a nominal height of 1,6 m without an operator being present, and the microphone shall be directed towards the machine.

The emission sound pressure level at the work station and at other specified positions shall be determined, over a typical period of operation of the machine under test. The measurement time shall be at least 30 s and represent a minimum of 5 cycles.

For steady noise further measurement time can be reduced as stable value has been reached according to the characteristics of the instrument used.

For unsteady noise levels it is important to specify carefully the period of observation; in particular an appropriate measuring period shall be selected and stated in the test report.

For machines operating in a production line noise measurement shall be carried out after commissioning.

5.2 Background noise correction K_1

Details about the evaluation of quantities related to the determination of the background noise correction K_1 are provided in Annex B (normative).

5.3 Local environmental correction K_3

Details about the evaluation of quantities related to the determination of the environmental correction K_2 and of the local environmental correction K_3 are provided in Annex B (normative).

6 Determination of the sound power level

6.1 General method

Sound power level shall be determined in compliance with one of the following standards: EN ISO 3744, EN ISO 9614-2, EN ISO 3746, EN ISO 3747. See Annex C (normative) for guidance on the selection of the standard.

6.2 Alternative method for very large machines

For very large machines, instead of the sound power level, it is permissible to determine and declare emission sound pressure levels at specified measurement points around the machine.

Such points shall be specified along a path around the machine at a height of 1,6 m above the ground plane on which the operator normally stands and at a distance of 1 m from the machine.

7 Assembly and installation conditions

The machine shall be assembled and installed in compliance with the manufacturer's instructions. If several modes are possible, a typical condition shall be recommended by the manufacturer and a detailed description shall be stated in the test report.

The assembling and installation conditions of the machine shall be identical for determining both the emission sound pressure level at the work places and other specified measuring points and the sound power level as specified in Annex D (informative).

Care shall be taken to avoid a significant amount of sound energy caused by the installation, the mounting system, set platforms, electrical conduits, piping or air ducts connected to the machine for the test. If an associated equipment necessary for operation of the machine under test is not supplied with the machine, it shall be located outside the test environment or, where this is not possible, its noise emission shall be considered as background noise.

If resilient mounts are interposed between the machine and the foundation to reduce any structure borne noise transmission, technical specifications shall be given for these resilient mounts and their application shall be stated in the test report.

8 Operating conditions

The definition of operating and environmental conditions is essential in order to determine the noise emission values. These operating conditions shall be representative of the intended use of the machine and shall be identical for determining both the emission sound pressure level at the work places and other specified measuring points and the sound power level, even where operating conditions are not defined. The operating conditions shall be stated in the test report as described in Annex D (informative).

There are two different type of operating conditions:

a) a constant noise emission level: this operating condition shall then be used for the measurement;

b) a non-constant noise emission level: if so, the time of the principal work cycle shall be divided in a few parts, defined sub-cycles.

Where work cycles are used for measurement and fluctuations of the A-weighted sound pressure level occurring during such cycles exceed 5 dB(A), the cycles shall be divided into operational sub-cycles during which specific operating conditions exist and Subclause 5.1 applies. Where subdividing the work cycle into sub-cycles is not possible, and the time-averaged sound pressure level shall be determined for the whole work cycle and be reported.

The machine under test shall be measured in typical usage with product intended to be used by the machine, at the nominal production speed as specified by the manufacturer, to reproduce the sound pressure level representative of normal use.

If there are difficulties regarding a continuous operation of the machine with original product, e.g. unavailable products, perishable products, etc., the measurements shall be done with an artificial product, with the same noise emission characteristics as the foreseen product. Where this is not possible, the measurements shall be carried out, under the same conditions, without product.

On machine with varying applications, separate noise measurements shall be taken for the specific applications intended in compliance with Annex D (informative).

In the case of machine or packaging line where final assembling can only be completed at the user's production environment, the sound pressure level measurements shall be done in this final environment. The test report shall indicate all information concerning the machine or packaging line conditions, the environment and the type of product used for the measurements.

9 Measurement uncertainty

The measurement uncertainty of the noise emission values will comply with the accuracy grade of the method applied. Accuracy grades are specified in the standards for determining emission sound pressure levels (see Clause 5) and sound power levels (see Clause 6).

The standard deviation of reproducibility σ_R is expected as shown in Table 1.

Table 1 — Expected standard deviation of reproducibility σ_R

Applied Standard & Grade	σ_R *(dB)*		Applied Standard & Grade	σ_R *(dB)*
EN ISO 11201, grade 2	< 2,5		EN ISO 3744, grade 2	< 1,5
EN ISO 11202, grade 3	< 5		EN ISO 3746, grade 3	< 4
EN ISO 11203, grade 2 or 3	According to sound power level standard		EN ISO 3747, grade 3	< 4
EN ISO 11204 grade 2	< 2,5		EN ISO 9614-2, grade 2	< 1,5
EN ISO 11204 grade 3	< 5,0		EN ISO 9614-2, grade 3	< 4

The estimate of the uncertainty affecting the measurement can be done accordingly with Subclause A.2.2 of EN ISO 4871:1996, starting from the values of standard deviation of reproducibility shown above.

10 Information to be recorded

The information to be recorded covers all the technical requirements of this standard. Any deviation shall be recorded with the technical justification.

11 Information to be reported

The test report of the noise measurements shall include the following information:

a) Test data

   1) place and date;

   2) basic standard applied and the accuracy grade;

   3) person responsible for the test;

b) Machine data

1) manufacturer;
2) type and model;
3) serial number;
4) year of manufacture;
5) dimensions;
6) installation conditions;

c) Machine operating conditions

1) running speed;
2) description of product;
3) location of machine in the test environment;

d) Instrumentation

1) manufacturer, type, serial number and last calibration;
2) windscreen type (if used);

e) Environmental parameters

1) physical parameter and dimensions;
2) description of walls, ceiling and floor;
3) acoustical qualification of room;

f) Measurement conditions

1) reference surface dimensions;
2) distance of measurement and number of points;
3) measurement surface dimensions and area S;
4) background noise correction;
5) drawing of machine arrangement (lay-out) with work station;
6) drawing of machine arrangement (lay-out) with all measuring points;

g) Sound pressure level:

1) background noise correction K_{1A};
2) environmental correction K_{2A} ;
3) local environmental correction K_{3A};
4) A-weighted emission sound pressure level at work station L_{pA};
5) if required, C-weighted peak emission sound pressure level at work station L_{pCpeak};

6) uncertainty;

7) if required, impulse noise content at work station according to Annex D of EN ISO 3744:1995 or EN ISO 3746:1995;

8) when work cycles are split into sub-cycles, measuring results that shall be provided for each sub-cycle;

h) Sound power level, if required:

1) A-weighted emission sound pressure levels at each measuring point;

2) A-weighted sound pressure levels of the background noise at each measuring point;

3) A-weighted surface-averaged sound pressure level;

4) measurement surface value:

$$L_s = 10 \lg\left(\frac{S}{S_0}\right)$$

where

S_0 = 1 m^2;

5) A-weighted sound power level L_{wA};

6) A-weighted emission sound pressure levels at each measuring point if Subclause 6.2 is used;

7) uncertainty.

12 Information and verification of noise emission values

The information of the noise emission values is the sole responsibility of the manufacturer or his appointed representative. According to EN ISO 4871, dual number method shall be applied (see Annex B.2 of EN ISO 4871:1996). If machine specific values for the uncertainty K are unavailable, respective values shall be taken from A.2.2 of EN ISO 4871:1996, with K = 1,645 σ_R where σ_R depends on used reference standards.

The verification shall be done using the same assembly, installation and operating condition of the initial determination noise emission values.

If this is not possible, the verification shall be carried out at condition being as close as possible to initial ones. Any divergences shall be documented.

According to EN ISO 4871 dual number method, the uncertainty shall be only considered as a quality indicator of the measurement and shall not affect the noise measurement value indicated by the manufacturer.

Annex A
(normative)

Selection of the appropriate standard for the measurement of the sound pressure level at the work station

The standard EN ISO 11200 contains detailed procedure for the selection of the appropriate method for measuring the emission sound pressure level at the work station.

The general concept is to always prefer the standard able to better accuracy and better rejection of causes of error. In this sense, the hierarchy of the standards is the following, in order of decreasing accuracy:

1) EN ISO 11201 (Engineering method in an essentially free field over a reflecting plane)

2) EN ISO 11203 (Engineering method from the sound power level)

3) EN ISO 11204 (Engineering method requiring environmental correction)

4) EN ISO 11202 (Survey method *in situ*)

Whenever it is not possible to employ the top-ranked standard, the user shall switch to the following standard in the above list. Justification of the causes impeding to employ the rejected standards shall be given in the measurement report.

The selection procedure shall be driven according to the following flowchart.

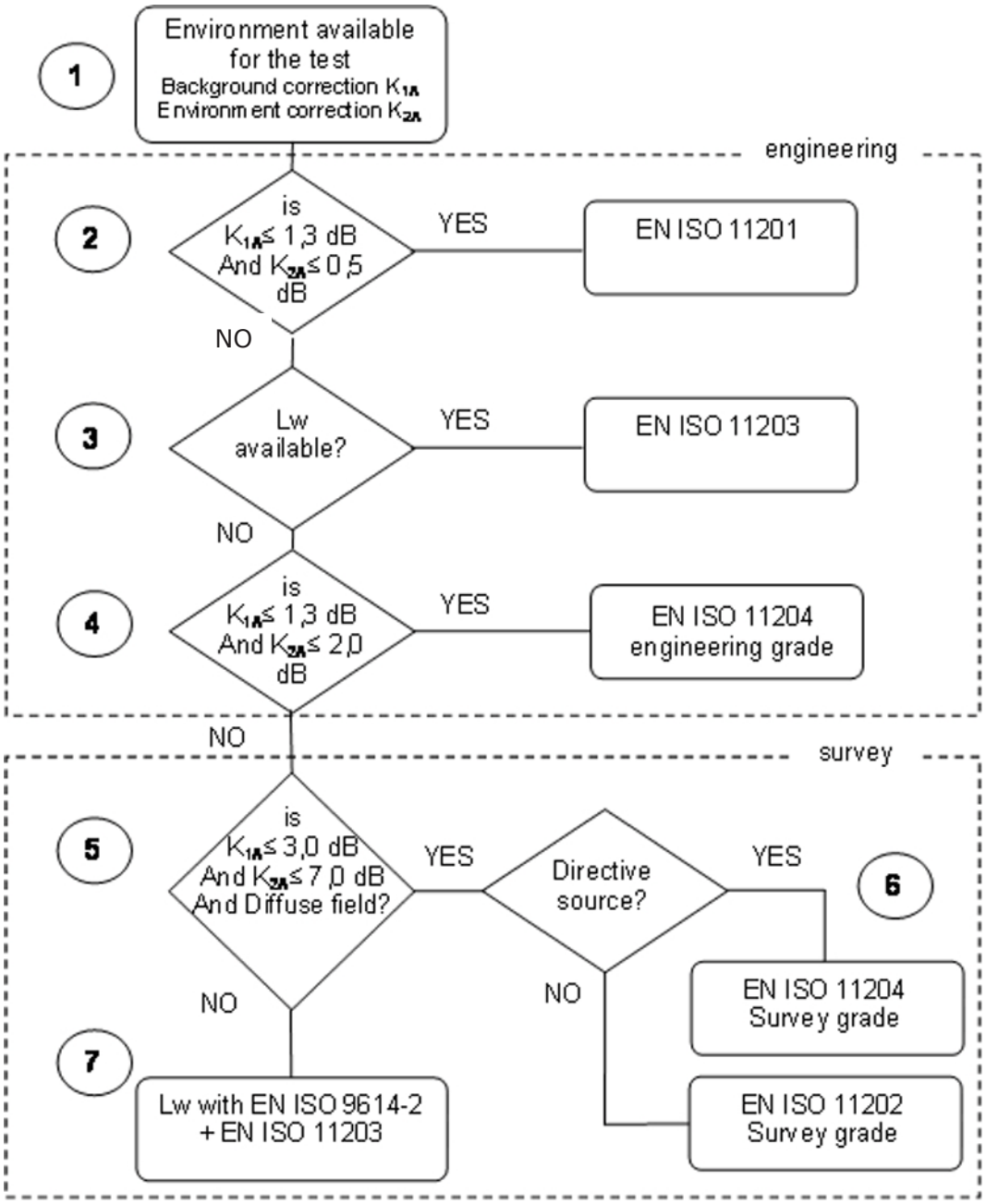

Figure A.1 — Flow Chart for the selection of the measurement standard for emission sound pressure level at the work station

Description of the selection blocks:

1) It is assumed that it is possible to evaluate the environmental conditions before selecting the measurement standard. The condition of some industrial environments, as for example rooms with low height and large horizontal dimensions, lead to the assumption that the sound field is not perfectly diffuse.

2) Whenever a semi-anechoic room is available, or it is possible to test the machine outdoors, the preferred method is always EN ISO 11201.

3) Whenever sound power level L_{WA} is measured, it is preferred to employ it for evaluating the emission sound pressure level at work station by means of EN ISO 11203, provided that it is possible to comply with the engineering grade limitations.

4) Whenever the previous methods cannot be employed, EN ISO 11204 is employed if the environmental conditions allow for its application with Grade 2 (engineering grade) accuracy.

5) Grade 3 (survey grade) methods are employed when the conditions previously set for the application of grade 2 (engineering) methods cannot be fulfilled. However, survey grade methods could also be employed when operating conditions of the machines do not allow for long measurement times, e.g. due to lacking of product to be processed or to other operational limitations during the test.

6) The standard EN ISO 11204 takes into account the case of sound sources with strong directivity. When the sound source is not highly directive, the standard EN ISO 11202 is applicable. However, these standards operate correctly only under strict conditions of diffuse sound field. If the sound field is not perfectly diffuse, the evaluation of environmental correction factor K_2 and of local environmental correction factor K_3 is possible following the guidance given in Annex B.

7) When the background noise is very high, or the environmental correction factor is a great number, or the sound field is not complying with the assumption of a diffuse field, the only way of estimating the emission pressure level at the work station is to measure the sound power level of the machine employing the sound intensity method (EN ISO 9614-2) with survey grade and to derive the sound pressure level at the work station by means of EN ISO 11203.

NOTE 1 The diffuse field occurs when, in the test environment, the sound waves are repeatedly reflected in all directions with equal magnitude and probability (e.g. industrial environment with flat and smooth ceiling and walls).

NOTE 2 The directive source occurs when the emission sound pressure level of the source is mainly headed in only one direction.

Annex B
(normative)

Evaluation of local environmental correction K_3

B.1 Background noise correction K_1

The background noise correction K_1 is evaluated according to the following formula:

$$K_1 = -10 \cdot \lg\left[1 - 10^{-0.1 \cdot \Delta L}\right] \quad \text{(B.1)}$$

where

ΔL is the difference between the sound pressure level measured, at a specified position, with the machine under test in operation and turned off, respectively.

When the machine to be tested can operate only as part of a production line, the noise emission of the other components of the line has to be interpreted as background noise, which could be too high and thus unacceptable, (K_1 > 3 dB). Furthermore, it is not possible to turn off the machine under test, while leaving the other components of the production line operational.

In this case, the following options are available:

1) If the manufacturer is only responsible of the noise emitted by the single machine, the only viable method is to determine the sound power level by applying the sound intensity measurement method as described in EN ISO 9614-2 and deriving the emission sound pressure level at the work station by employing EN ISO 11203.

2) If the machine is supplied together with the other components of the production line, then the noise emission of these other components should not be considered part of the background noise. The measurement of the background noise will be performed with the whole production line not in activity.

3) If only part of the other components of the production line is supplied with the machine under test, it is necessary to estimate the background noise caused at the work station by the part of the components of the production line which are not being supplied together with the machine under test. This estimate can only be done by knowing the sound power level emitted by each of these components, and employing EN ISO 11203 for estimating the sound pressure level at the work station caused by these components.

B.2 Local environmental correction K_3 (EN ISO 11202)

The evaluation of the environmental factor K_3 is based on the following formula, taken from Annex A of EN ISO 11202:1995, Equation (A.1):

$$K_3 = 10 \cdot \lg\left[1 + 4\frac{S}{A}\right] \quad \text{(B.2)}$$

where

$S = 2 \cdot \pi \cdot a^2$

The formula above is correct only in a perfectly diffuse field.

EN ISO 11202 allows for the specification of a suitable value of “a”, based on specific type of machinery under test. With reference to the packaging machinery, the value of “a” is specified to be an effective source-receiver distance which can be estimated by the following formula:

$$a = \sqrt{\frac{S'}{2\pi}} \qquad \text{(B.3)}$$

where

S’ is a surface enveloping strictly the shape of the machine, at a distance from the surface of the machine which is typically equal to 1m, or, in general, passes through the work station position, where the measurement of the sound pressure level is done.

This strictly enveloping surface S’ is, in general, different from the measurement surface S employed for measuring the sound power level with standards EN ISO 3744 and EN ISO 3746, which has a more regular shape. For example, in the case of a machine which has an L-shape, also the strictly enveloping surface S’ has the same shape, as shown in the following Figure B.1.

NOTE 1 The overhead position(s) may be deleted when it can be proven that this will not affect the final average level, if so stated in the test report;

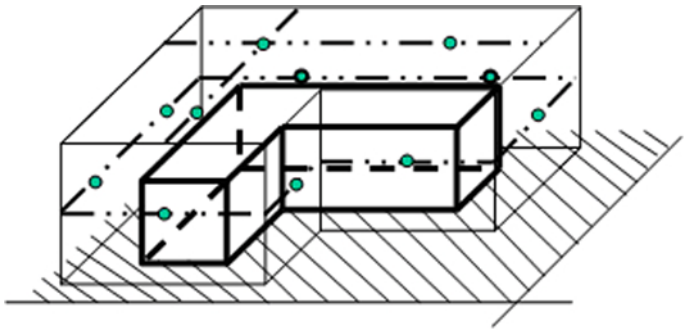

Figure B.1 – Strictly enveloping surface around an L-shaped machine

The value of A in Equation (A.1) is evaluated as follows:

$$A = \alpha \cdot S_V \qquad \text{(B.4)}$$

where

α is the mean acoustic absorption coefficient of the test room as estimated from Table A.1 in Annex A of EN ISO 3744:1995 or EN ISO 3746:1995;

S_V is the total area of the test room (walls, ceiling and floor) in square metres.

The selection of the most appropriate mean sound absorption coefficient α is given in Annex D (informative).

NOTE 2 The equation above does not describe correctly the environment when any of the following cases happens:

— Strong sound reflections from walls and ceiling;

— Uneven distribution of the absorption;

— Low and large room (w / h > 3, where: w = smaller lateral dimension and h= height);

— Very large room (V > 2500 m^3, where V=volume of room).

In all these cases "in situ" experimental tests should be made to determine the environmental correction K_2 (e.g. A.3, EN ISO 3744:1995, or A.3.1, EN ISO 3746:1995), employing a distance from the reference sound source and the measurement point equal to the value of “a” defined in Equation (B.3) above.

NOTE 3 On this subject the annex bibliography offers useful information.

B.3 Local correction factor K_3 (EN ISO 11204)

The evaluation of the local environment factor K_3 shall be done according to Annex A.2 of EN ISO 11204:1995, based on the knowledge of environment correction K_2, employing the following formula:

$$K_3 = -10 \cdot \lg\left[1 - \left(1 - 10^{-0.1 \cdot K_2}\right) \cdot 10^{-0.1 \cdot \left(L'_j - \overline{L'}\right)}\right] \quad \text{(B.5)}$$

Among the methods for estimating the environment correction K_2 contained in the annexes of EN ISO 3744:1995 and EN ISO 3746:1995, it is recommended to choose the most suitable one for the environment where the measurement is made.

Particular care must be taken whenever the environment does not provide diffuse sound field, due to any of the causes outlined in Subclause B.2. In these cases "in situ" experimental tests should be made to determine the environmental correction K_2. (e.g. A.3, EN ISO 3744:1995 or A.3.1, EN ISO 3746:1995), employing a distance from the reference sound source and the measurement point equal to the value of "a" defined in Equation (B.3) above.

The above formulation is not working correctly when any of the following cases happens:

— the machine has strong emission from its top, (e.g. machine which is completely surrounded by soundproof shields but with open area above);

— the emission from the top is negligible compared to the emission from localized points around the machine;

— the work station is not properly shielded from the noise radiated by the machine;

— the reverberant field is not uniform around the machine (e.g. the machine is close to a reflecting surface).

In these cases, the result is affected by a systematic error, and there is a significant chance that the resulting value of K_3 is underestimated. This fact shall be outlined in the test report, and an alternative measurement standard is recommended (e.g. EN ISO 11203).

Alternatively, it is possible to get a better estimate of the local environment correction K_3 assuming that it is identical to DLf, as defined in EN ISO 11690, parts 1 and 3, and measured according to EN ISO 14257.

Annex C
(normative)

Selection of appropriate standard for sound power level measurement

The standard EN ISO 3740 contains detailed guidance for the selection of the appropriate standard for measuring the sound power level of a machine.

However, the selection of the appropriate standard for measuring the emission sound pressure level at the work station of packaging machines is given here in more detail.

Among the available standards, the following are those recommended for measurement of the sound power level of packaging machines:

— EN ISO 9614-2 (Determination of sound power levels of noise sources using sound intensity - Measurement by scanning);

— EN ISO 3744 (Engineering method in an essentially free field over a reflecting plane);

— EN ISO 3746 (Survey method using an enveloping measurement surface over a reflecting plane);

— EN ISO 3747 (Comparison method for use in situ).

The general concept is to always prefer the standard capable of better accuracy and better rejection of causes of error. In this sense, the hierarchy of the standards is the following, in order of decreasing accuracy:

1) EN ISO 3744;

2) EN ISO 9614-2 – engineering grade;

3) EN ISO 3746;

4) EN ISO 9614-2 – survey grade;

5) EN ISO 3747.

Whenever it is not possible to employ the top-ranked standard, the user shall switch to the following standard in the list above. Justification of the causes impeding to employ the rejected standards shall be given in the measurement report.

The selection procedure can be driven according with the following flowchart.

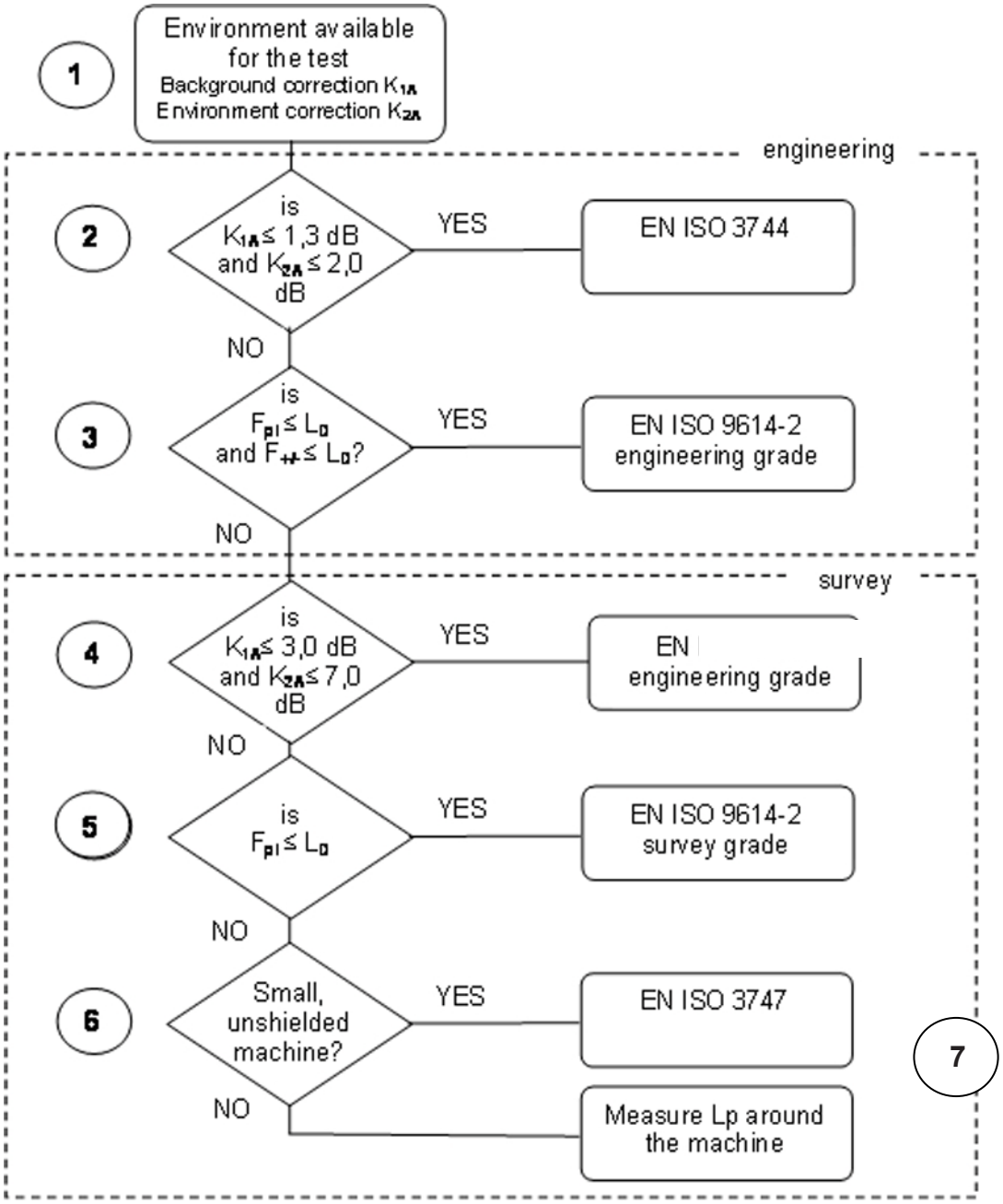

Figure C.1 – Flow chart for the selection of the measurement standard for sound power level

Description of the selection blocks:

1) It is assumed that it is possible to evaluate the environmental conditions before selecting the measurement standard. The condition of some industrial environments, as for example buildings with low height and large horizontal dimensions, lead to the assumption that the sound field is not perfectly diffuse.

2) Whenever the environment qualifies, the standard EN ISO 3744 is recommended.

3) In presence of strong background noise or reverberant environment, EN ISO 9614-2 can be used, provided that the field indicators described in Annex A of EN ISO 9614-2:1996 respect the limits stated for reaching the engineering grade (grade 2).

4) Whenever the environment qualifies, the standard EN ISO 3746 is recommended

5) In presence of strong background noise or reverberant environment, EN ISO 9614-2 can be used, provided that the field indicators described in Annex A of EN ISO 9614-2:1996 respect the limits stated for reaching the survey grade (grade 3).

6) If the machine under test has his larger dimension less than 2m and does not have shields surrounding the machine, the EN ISO 3747 method can be applied.

7) When no sound power level measurement can be performed (e.g. very large machines or plants), it is permissible to determine and declare emission sound pressure levels at specified measurement points around the machine, as stated in Clause 6.2.

NOTE 1 When EN ISO 3744 or EN ISO 3746 are employed in an environment characterized by not diffuse sound field, as detailed below, special care must be taken during the estimation of the environmental correction K_2. This happens in the following cases:

— Strong sound reflections from walls and ceiling;

— Uneven distribution of the absorption;

— Low and large room:

w / h > 3

where

w = smaller lateral dimension;

h= height;

— Very large room:

V > 2500 m^3;

where

V = volume of the room.

In all these cases "in situ" experimental tests should be made to determine the environment correction K_2. (e.g., A.3, EN ISO 3744:1995, or A.3.1, EN ISO 3746:1995).

On this subject the final bibliography offers useful information.

NOTE 2 For the parameters definition F_{pl}; $F_{+/-}$ and L_D stated on the above flow-chart see standard EN ISO 9614-2.

Annex D
(informative)

Information on the machine under test and environmental conditions

1. Machine under test	Type Description Machine Layout Supports Safety Guards Note
2.Technical Project	Packaging Type Packaging dimensions In-feed product type Out-feed product type Note
3. Dimension of the machine	Standard machine Very large machine
4. Associated equipment delivered with the machine	(if present)
5. Associated equipment not delivered with the machine	(if present)

6. Work station description	Standard operator position At 1 meter from : Control panel Infeed product aperture Discharge product aperture Others positions
7. Operating conditions	Nominal speed Operating speed Product condition With standard product or With similar product or Without product Note

8. Environment description	Room Volume: little (<500 m^3) medium (500 - 1500 m^3) large (1500 - 2500 m^3) very large (>2500 m^3) Room shape: regular irregular Room condition: nearly empty partly empty with some furniture or machinery with many furniture or machinery Ceiling: hard reflecting (e.g. smooth ceiling) with small amount of absorbing material with large amount of absorbing material Walls: hard reflecting (e.g. glass window, smooth wall) with small amount of absorbing material with large amount of absorbing material Note: For the selection of the appropriate coefficient "**α**" see the following indication(Point 9)

9. Environment description for the most appropriate value of "α"																			
Room Shape	Regular (e.g. rectangular industrial room)	X	X	X	X	X	X	X	X	X									
	Irregular										X	X	X	X	X	X	X	X	X
Room Condition	Empty	X	X	X							X	X	X						
	Partly empty				X	X	X							X	X	X			
	With furniture							X	X	X							X	X	X
Ceiling and Walls	Hard reflection (e.g. smooth ceiling or glass-window in the wall)	X			X			X			X			X			X		
	With small amount of sound-absorbing material		X			X			X			X			X			X	
	With large amount of sound-absorbing material			X			X			X			X			X			X
α		**0,05**	**0,25**	**0,40**	**0,10**	**0,30**	**0,45**	**0,15**	**0,35**	**0,50**	**0,10**	**0,30**	**0,45**	**0,15**	**0,35**	**0,45**	**0,20**	**0,40**	**0,50**

Annex E
(informative)

NOISE MEASUREMENT REPORT

Noise Measurement Report			
Place		Date	
Operator		Manager:	

1. MACHINE DATA

Manufacturer		Costumer	
Model			
Serial Number			
Installation conditions			
Supports description			
Guards description			
Very large machine			

2. MACHINE OPERATING CONDITIONS

Running speed					
With product		With simulated product		Without product	
Operative functions enabled		Not enabled		In function only for noise test	
Localization of the machine					
In external free-field		In semi-anechoic room			
In operative environment					
Manufacturer		Customer		Other	
Note					

3. INSTRUMENTS USED

INSTRUMENT	BUILT BY	MODEL	SERIAL No.	ADJUSTMENT DATE
Sound Level Calibrator				
Sound Level Meter				

4. ENVIRONMENT PARAMETERS

Physical parameters:									
Temp. (°C.):		Pressure (mbar):		Humidity (%):					
Environment Parameters:									
Ceiling									
Floor									
Walls									
Length (m)		Width(m)		Ht. (m)		Tot. Area (m^2)		Volume (m^3)	
Acoustic Parameters									
Riverberation Time (sec.)		Sabin Total Absorbing Material: A (m^2)				α			
Reference method and standard to determine K_{2A}									
Environment correction K_{2A}								dB(A)	
Reference method and standard to determine K_{3A}									
Local environment correction K_{3A}								dB(A)	

5. MEASUREMENT POSITIONS

Reference surface					
Length (m)		Width (m)		Height (m)	
Measurement distance (m)			Height from the floor (m)		
Measurement surface					
Length (m)		Width (m):		Height (m)	
Area measurement surface (m^2)			Ls =10 Log S/So (dB)		
No. of work station			No. of measurement positions		

6. MACHINE LAYOUT

7. MEASUREMENT POSITIONS & LEVELS

POINT N°	Measured sound pressure level L'_{pAi} dB(A)	Measured Background Noise Level L''_{pAi} dB(A)	Background correction K_{1A} dB(A)	Environment correction K_{2A} dB(A)	Local environment correction K_{3A} dB(A)	Correct Sound pressure level L_{pAi} dB(A)
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
Average						

Work-station N°	L'_{pAi} dB(A)	L''_{pAi} dB(A)	K_{1A} dB(A)	K_{2A} dB(A)	K_{3A} dB(A)	L_{pAi} dB(A)
ws 1						
ws 2						
ws 3						
ws 4						
ws 5						

8. INFORMATION ON NOISE EMISSION LEVEL

Peak(C)-weighted sound pressure level at work station if required			$dB(C)_{peak}$
Background Noise Correction	K_{1A}		dB(A)
Environment Correction	K_{2A}		dB(A)
Local Environment Correction	K_{3A}		dB(A)
A-weighted sound pressure level at work-station	L_{pA}		dB(A)
Uncertainty K_{pA}			dB
Further information if required			
A-weighted surface sound pressure level	L_{pfA}		dB(A)
Measurement Surface	L_s		dB
A-weighted sound power level (ref. 1pW)	L_{wA}		dB(A)
Uncertainty K_{WA}			dB

Reference standards:
- for sound pressure level at work station:……
- for sound power level:……

Note:

Annex ZA
(informative)

Relationship between this European Standard and the Essential Requirements of EU Directive 98/37/EC

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association to provide one means of conforming to Essential Requirements 1.7.4.f of the New Approach Directive.

For Machinery 98/37/EC, amended by Directive 98/79/EC.

Once this standard is cited in the Official Journal of the European Union under that Directive and has been implemented as a national standard in at least one Member State, in compliance with the clauses of this standard confers, within the limits of the scope of this standard, a presumption of conformity with the corresponding Essential Requirements of that Directive and associated EFTA regulations.

WARNING — Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard.

Annex ZB
(informative)

Relationship between this European Standard and the Essential Requirements of EU Directive 2006/42/EC

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association to provide one means of conforming to Essential Requirements 1.7.4.2.u and 1.5.8 of the New Approach Directive.

For Machinery 2006/42/EC,

Once this standard is cited in the Official Journal of the European Union under that Directive and has been implemented as a national standard in at least one Member State, in compliance with the clauses of this standard confers, within the limits of the scope of this standard, a presumption of conformity with the corresponding Essential Requirements of that Directive and associated EFTA regulations.

WARNING — Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard.

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