INTERNATIONAL STANDARD

ISO 8960

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Refrigerators, frozen-food storage cabinets and food freezers for household and similar use — Measurement of emission of airborne acoustical noise

Réfrigérateurs, conservateurs et congélateurs à usage ménager et analogue — Mesure de l'émission du bruit aérien

Reference number
ISO 8960:1991(E)

Foreword

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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 8960 was prepared by Technical Committee ISO/TC 86, *Refrigeration*.

Annexes A and B of this International Standard are for information only.

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Introduction

The clause numbers in this International Standard correspond to those in IEC 704-1 on which the measurement method described in this International Standard is based.

For the purposes of this International Standard, the heading "**Replacement**" indicates that the text given in this International Standard replaces the relevant text in IEC 704-1; similarly the heading "**Addition**" indicates that the text given in this International Standard supplements the relevant text in IEC 704-1.

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Refrigerators, frozen-food storage cabinets and food freezers for household and similar use — Measurement of emission of airborne acoustical noise

1 Scope

This International Standard specifies methods for measuring airborne acoustical noise emitted by electric refrigerators, frozen-food storage cabinets, food freezers and their combinations for household and similar uses, supplied from the mains or from batteries.

The term "similar use" means "use under conditions similar to those in a household", e.g. in cafés, restaurants, hotels and similar establishments.

This International Standard does not apply to appliances, equipment or machines designed exclusively for industrial or commercial purposes.

This International Standard is concerned with objective methods of engineering accuracy (engineering method, grade 2 according to ISO 2204) for determining sound power levels, L_W, expressed in decibels with reference to a sound power of 1 pW, of airborne acoustical noise within the specified frequency range of interest, and for specified operating conditions of the appliance to be measured.

The frequency range of interest includes the octave bands with centre frequencies between 125 Hz and 8 000 Hz (this interval being, for practical reasons, narrower than the frequency range of audible sound).

The following sound power levels are used:

— A-weighted sound power level, L_{WA}, and

— octave band sound power levels, L_{WOct}.

In general, the methods described are specified for appliances operated with no operator present.

The noise measurements are made while the compressors are running.

Requirements as to an indication of the noise emission values are not the subject of this International Standard.

NOTES

1 The uncertainties of measurement according to this International Standard usually result, for A-weighted sound power levels, in standard deviations generally not exceeding approximately 2 dB, provided that the noise spectrum does not contain pronounced discrete frequencies; if it does, the magnitude of the uncertainties will be larger. The standard deviations referred to reflect the cumulative effects of all causes of measurement uncertainties, excluding variations in the noise level of the appliance from test to test.

2 The noise values obtained under the conditions described in this International Standard will not necessarily correspond with the noise experienced under the operational conditions of practical use (see 6.4.1).

3 For quality control during production, etc., simplified methods may be appropriate. For noise control purposes (e.g. development of quieter appliances, insulation of equipment, etc.), other measurement methods using, for example, narrow-band frequency analysis will usually have to be applied. These methods are not covered in this International Standard.

This International Standard does not include methods for determining sound power levels with precision accuracy (precision method, grade 1 according to ISO 2204) specified, for example, in ISO 3741, ISO 3742 and ISO 3745; they may, however, be applied if the appropriate instrumentation and test environment are available.

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 encour-

aged 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.

IEC 704-1:1982, *Test code for the determination of airborne acoustical noise emitted by household and similar electrical appliances — Part 1: General requirements.*

3 Terms and definitions

Clause 3 of IEC 704-1 is applicable.

4 Measurement methods and acoustical environments

Clause 4 of IEC 704-1 is applicable.

5 Instrumentation

Clause 5 of IEC 704-1 is applicable.

6 Operation and location of appliances under test

Clause 6 of IEC 704-1 is applicable with the following modifications.

6.1 Equipping and pre-conditioning of appliances

6.1.2 Addition

Loose components inside the appliance which create undue vibrations (e.g. shelves or ice trays) shall be secured, for example by tape, or may be adjusted.

Adjustable feet (if any) shall be adjusted to attain minimum noise emission.

Doors or lids shall be closed.

6.1.3 Replacement

Prior to noise measurements, the appliance, equipped as for the intended use, shall have been in operation for at least 16 h for running-in at a room temperature of 25 °C ± 5 K.

The thermostat shall be set for the specified test temperature, which may be found during this running-in period.

6.1.4 Replacement

Immediately before each series of noise measurements, the appliances shall be operated until a steady state has been reached but at least for three complete operating cycles. Steady-state conditions are considered as being achieved when the duration of the compressor running time does not deviate by more than 10 % from the running time of the previous cycle.

6.2 Supply of electric energy

6.2.1 Replacement

Appliances with mains-powered electric motor(s) shall be supplied with nominal system voltage and frequency for the country in which the appliance is intended to be used, with a tolerance of ± 1 % on voltage and ± 1 Hz on frequency. These values may deviate from the manufacturer's rated voltage and frequency.

The supply voltage shall be measured at the plug of a non-detachable cable or cord, or at the appliance inlet if a detachable cable is provided, but in no case at the entrance of extension cables or cords.

6.2.2 Replacement

Appliances with battery-powered electric motors shall be operated at the manufacturer's recommended voltage, with a tolerance of ± 1 %.

6.3 Climatic and temperature conditions

Replacement

The appliance shall be operated under the following conditions:

Test room conditions

Ambient temperature: 22 °C ± 3 K

Relative humidity: 30 % to 85 %

Atmospheric pressure: 86 kPa to 106 kPa (860 mbar to 1 060 mbar)

The ambient temperature shall be measured 1 m above the floor of the test room, 35 cm to one side of the cabinet.

The vertical temperature gradient shall not exceed 2 K/m.

Cabinet internal temperature

Refrigerators:

Fresh-food storage compartment: 5 °C ± 2 K

Frozen-food storage compartment: no limitation

Chiller compartment (if applicable): no limitation

Freezers: $-22\ °C \pm 2\ K$

Refrigerators-freezers:

Fresh-food storage compartment: $5\ °C \pm 2\ K$

Food freezer compartment without separate thermostat: no limitation

Food freezer compartment with separate thermostat: $-22\ °C \pm 2\ K$

Chiller compartment (if applicable): no limitation

NOTE 4 This temperature is the air temperature and not the temperature that is measured in test packages in accordance with ISO 5155 and ISO 8187. An air temperature of $-22\ °C$ approximately corresponds to a test package temperature of $-18\ °C$.

These temperatures shall be measured by a thermocouple weighted by a copper cylinder with a mass of 25 g in the geometric centre of the storage compartment; they shall be considered to be the mean values during a total operating cycle.

6.4 Loading and operating of appliances

6.4.1 Addition

The appliance shall be operated without loading (i.e. empty).

Adjustable slots and openings between different compartments which may be operated by the user shall be closed.

6.4.2 Replacement

The measurement shall commence 1 min after the start of a running period and shall pause at the end of the same running period.

The readings shall be taken at constant time intervals over at least three running periods.

At least 30 readings shall be taken. In the case of a moving microphone, the measurements may be made continuously over at least three running periods.

NOTE 5 This averaging can be made automatically with an I_{eq} meter connected to the moving microphone or to the multiplexer which has to be used in the case of fixed microphone positions.

The readings shall be averaged on an energy basis.

Combined appliances with two compressors shall be tested with the refrigerator unit operating under the specified temperature conditions and the freezer unit operating continuously. The highest result shall be reported.

NOTE 6 In the case of simultaneous running of two compressors, beats are possible.

6.4.3 Replacement

It is recommended to apply a graphic level recorder to make a recording of the A-weighted sound pressure level during the operational cycle(s) — time history — at one of the microphone positions (preferably in front of the appliance to be tested) or with a moving microphone.

From this time history, the running time of the compressor can be determined.

6.5 Location and mounting of appliances

6.5.2 Subclause 6.5.2 of IEC 704-1 is not applicable.

6.5.3 Replacement

Floor-standing appliances and counter-top or table-type appliances for placing against a wall shall be placed in a normal position, without any resilient means other than those incorporated or supplied with the appliance, either

— on the floor of the reverberation test room with a distance of 1 cm between the rear of the appliance and a wall and with a minimum distance of 1 m between any other surface of the appliance and the nearest corner of the room, or

— on the reflecting plane of the free-field environment and with a distance of 1 cm between the rear of the appliance and the second vertical reflecting plane (wall), giving consideration to the shape and size of the specified measurement surface.

For both types of test environment the following requirements shall be met:

— the acoustic absorption coefficient of the vertical wall shall be less than 0,06 inside the representative field of frequencies;

— care shall be taken to avoid any direct contact between the appliance (including protruding parts, work-tops, spacers, etc.) and the vertical reflecting wall;

— the distance between the vertical plane and the appliance shall be established by placing the appliance in direct contact with the wall and then moving it away for a distance of 1 cm.

6.5.4 Replacement

Wall-mounted appliances, including their accessories (if any), shall be fastened or held by an appropriate fixture in close contact, at a height of the lowest edge of approximately 0,5 m from the floor,

without any resilient means other than those incorporated or supplied with the appliance, either

— on a wall of the reverberation test room with a minimum distance of 1 m between any surface of the appliance and the nearest corner of the room, or

— on the second, vertical reflecting plane (wall) of the free-field environment, giving consideration to the shape and size of the specified measurement surface.

The acoustic absorption coefficient of the vertical wall shall be less than 0,06.

6.5.5 Replacement

Appliances for building-in shall be built in accordance with the manufacturer's instructions into appropriate cabinets without any resilient means other than those incorporated or supplied with the appliance. The cabinet, including the built-in appliance, shall be located as specified for floor-standing appliances for placing against a wall (see 6.5.3).

The cabinet shall consist of uncoated chipboard, 19 mm thick and having a density of 700 kg/m^3 $\pm$ 50 kg/m^3.

Irrespective of the manufacturer's instruction, the cabinet shall be closed at the rear with a sheet of the same material, taking into account openings for ventilation, if required.

7 Measurement of noise levels

Clause 7 of IEC 704-1 is applicable with the following modifications.

7.1 Microphone array and measurement surface for free-field conditions

7.1.1 Addition

For wall-mounted appliances, the measurement surface according to 7.1.2 (figure 2) shall be used.

7.1.5, 7.1.6, 7.1.7 and **7.1.8**

These subclauses of IEC 704-1 are not applicable.

7.1.11 Addition

NOTE 7 For a simple comparison of appliances in the same category, type and size (for example, for quality control measurements during production), the number of microphone positions may be reduced, for example to the single position recommended for the several arrays for determining time histories, frequency spectra, etc.

8 Calculation of sound pressure and sound power levels

Clause 8 of IEC 704-1 is applicable.

9 Information to be recorded

Clause 9 of IEC 704-1 is applicable with the following modification.

9.7.3, 9.7.4 and **9.9.1**

These subclauses of IEC 704-1 are not applicable.

10 Information to be reported

Clause 10 of IEC 704-1 is applicable with the following modification.

10.3.4, 10.3.5 and **10.3.9**

These subclauses of IEC 704-1 are not applicable.

Annex A
(informative)

Guidelines for the design of simple test rooms with essentially free-field conditions

Appendix A of IEC 704-1 is applicable.

Annex B
(informative)

Bibliography

[1] ISO 2204:1979, *Acoustics — Guide to International Standards on the measurement of airborne acoustical noise and evaluation of its effects on human beings.*

[2] ISO 3741:1988, *Acoustics — Determination of sound power levels of noise sources — Precision methods for broad-band sources in reverberation rooms.*

[3] ISO 3742:1988, *Acoustics — Determination of sound power levels of noise sources — Precision methods for discrete-frequency and narrow-band sources in reverberation rooms.*

[4] ISO 3745:1977, *Acoustics — Determination of sound power levels of noise sources — Precision methods for anechoic and semi-anechoic rooms.*

[5] ISO 5155:1983, *Household frozen food storage cabinets and food freezers — Essential characteristics and test methods.*

[6] ISO 7371:1985, *Performance of household refrigerating appliances — Refrigerators with or without low temperature compartment.*

[7] ISO 8187:1991, *Household refrigerating appliances — Refrigerator-freezers — Characteristics and test methods.*