INTERNATIONAL STANDARD

ISO 4412-3

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Hydraulic fluid power — Test code for determination of airborne noise levels —

Part 3:

Pumps — Method using a parallelepiped microphone array

Transmissions hydrauliques — Code d'essai pour la détermination du niveau de bruit aérien —

Partie 3: Pompes — Méthode employant un étalage des microphones en parallélépipède

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Annexes

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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 4412-3 was prepared jointly by Technical Committees ISO/TC 131, *Fluid power systems*, Sub-Committee SC 8, *Product testing and contamination control* and ISO/TC 43, *Acoustics*.

ISO 4412 consists of the following parts, under the general title *Hydraulic fluid power — Test code for determination of airborne noise levels*:

— *Part 1: Pumps*

— *Part 2: Motors*

— *Part 3: Pumps — Method using a parallelepiped microphone array*

Annex A forms an integral part of this part of ISO 4412. Annex B is for information only.

Introduction

In hydraulic fluid power systems, power is transmitted and controlled through a liquid under pressure in a closed circuit. Pumps are components which convert rotary mechanical power into fluid power. During the process of converting mechanical power into hydraulic fluid power, airborne noise, fluid-borne vibrations and structure-borne vibrations are radiated from the pump.

The airborne noise level of a hydraulic fluid power pump is an important consideration in component selection. The noise measurement technique should, therefore, be such as to yield accurate appraisals of these airborne noise levels. The determination of noise levels is complicated by the interactions which occur during noise measurements. The fluid-borne and structure-borne vibrations from the pump can be transmitted to the circuit and ultimately give rise to background airborne noise levels which could affect the determination of the pump airborne noise levels.

The procedures described in this part of ISO 4412 are intended to measure only the airborne noise radiated directly from the pump under test.

This part of ISO 4412 closely follows the methods described in the two other parts, but allows the use of alternative pump mounting and drive configurations which are simpler and cheaper to implement in an anechoic chamber. Much of the guidance given in ISO 4412-1:1991, annex C, is equally applicable to this part of ISO 4412. The data obtained have been shown to be sufficiently accurate in engineering terms for A-weighted and one-third octave noise measurements, in decibels.

This part of ISO 4412 may also be applied to the testing of motors.

Hydraulic fluid power — Test code for determination of airborne noise levels —

Part 3:
Pumps — Method using a parallelepiped microphone array

1 Scope

This part of ISO 4412 describes procedures for the determination of the sound power levels of a hydraulic fluid power pump, under controlled conditions of installation and operation, suitable for providing a basis for comparing the noise levels of pumps in terms of

— A-weighted sound power level;

— one-third octave band power level.

From these sound power levels, if required, reference sound pressure levels may be calculated for reporting purposes (see clause 11).

For general purposes, the frequency range of interest includes the one-third octave bands with centre frequencies between 100 Hz and 10 000 Hz.[1)]

This part of ISO 4412 is applicable to all types of hydraulic fluid power pumps operating under steady-state conditions, irrespective of size, except for any limitations imposed by the size of the test environment (see clause 3).

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 4412. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 4412 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 3448:1975, *Industrial liquid lubricants — ISO viscosity classification.*

ISO 3744:1981, *Acoustics — Determination of sound power levels of noise sources — Engineering methods for free-field conditions over a reflecting plane.*

ISO 5598:1985, *Fluid power systems and components — Vocabulary.*

ISO 6743-4:1982, *Lubricants, industrial oils and related products (class L) — Classification — Part 4: Family H (Hydraulic systems).*

IEC 651:1979, *Sound level meters.*

3 Definitions

For the purposes of this part of ISO 4412, the definitions given in ISO 5598 and the following definitions apply. It is accepted that the latter definitions may differ from those in other specific International Standards.

3.1 free sound field: Sound field in a homogeneous, isotropic medium free of boundaries.

NOTE 1 In practice, it is a field in which the effects of the boundaries are negligible over the frequency range of interest.

3.2 free field over two reflecting planes: Field produced by a source in the presence of two mutually perpendicular reflecting planes.

1) 1 Hz = 1 s^{-1}

3.3 anechoic room: Test room having boundaries which absorb essentially all of the incident sound energy over the frequency range of interest, thereby affording free-field conditions over the measurement surface.

3.4 mean-square sound pressure: The sound pressure averaged in space and time on a mean-square basis.

NOTE 2 In practice, this is estimated by space and time averaging over a finite path length or over a number of fixed microphone positions.

3.5 mean sound pressure level (L_p): Ten times the logarithm to the base 10 of the ratio of the mean-square sound pressure to the square of the reference sound pressure, in decibels (dB).

NOTE 3 The weighting network or the width of the frequency band used should always be indicated; for example, A-weighted sound pressure level, octave band sound pressure level. The reference sound pressure is 20 μPa[2].

3.6 sound power level L_W: Ten times the logarithm to the base 10 of the ratio of a given sound power to the reference sound power, in decibels (dB).

NOTE 4 The weighting network or the width of the frequency band used should always be indicated. The reference sound power is 1 pW[3].

3.7 volume of source under test: Volume of the envelope of the whole pump under test.

3.8 reference box: Hypothetical reference surface which is the smallest rectangular parallelepiped that just encloses the pump and any large directly-attached appendages (such as valve bodies or control handwheels) and which terminates on the reflecting planes.

4 Measurement uncertainty

With the exception of the measurement environment specified in clause 5, use methods of measurement which tend to result in standard deviations which are equal to or less than those given in table 1. To meet this requirement, use the engineering methods given in ISO 3744: 1981, clause 4 and annex A.

Table 1 — Standard deviations of sound power level determinations

Standard deviation, dB, for one-third octave band centre frequencies			
100 Hz to 160 Hz	200 Hz to 630 Hz	800 Hz to 5000 Hz	6300 Hz to 10000 Hz
5,0	3,0	2,0	3,0

The standard deviations given in table 1 include the effects of allowable variations in the positioning of the measurement points and in the selection of any prescribed measurement surface, but exclude variations in the sound power output of the source from test to test.

NOTE 5 The A-weighted sound power level will in most practical cases be determined with a standard deviation of approximately 2 dB.

5 Test environment

Tests shall be conducted in an environment generally in accordance with that described in ISO 3744 and which provides free-field conditions over two mutually perpendicular reflecting planes, both of which extend beyond the projected area of the microphone measuring array.

Calibrate the acoustic test environment thus formed and ascertain the environmental corrections for each frequency band of interest, using the procedures described in ISO 3744:1981, annex A.

6 Instrumentation

6.1 The instrumentation used to measure fluid flow, fluid pressure, pump speed and fluid temperature shall be in accordance with the recommendations for "industrial class" accuracy of testing; i.e. class C given in annex A.

6.2 The instrumentation used for acoustical measurements shall be in accordance with IEC 651. This instrumentation shall be in accordance with ISO 3744 for both performance and calibration; i.e. type 2 instruments for engineering (grade 2) measurements.

2) 1 μPa = 10^{-6} N/m²

3) 1 pW = 10^{-12} W