

Measurement of airborne noise from hydraulic fluid power systems and components —

Part 2: Method of test for motors

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Machinery and Components Standards Policy Committee (MCE/-) to Technical Committee MCE/18, upon which the following bodies were represented:

- Advanced Manufacturing Technology Research Institute
- Association of British Mining Equipment Companies
- Bath University
- British Compressed Air Society
- British Fluid Power Association
- British Steel Industry
- Department of Trade and Industry (National Engineering Laboratory)
- Ministry of Defence

The following bodies were also represented in the drafting of the standard, through subcommittees and panels:

- British Hydromechanics Research Association
- British Railways Board
- Society of Motor Manufacturers and Traders Ltd.

This British Standard, having been prepared under the direction of the Machinery and Components Standards Policy Committee, was published under the authority of the Standards Board and comes into effect on 15 December 1992

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First published November 1980
Second edition December 1992

The following BSI references relate to the work on this standard:
Committee reference MCE/18
Draft for comment 89/78172 DC

ISBN 0 580 21396 X

Amendments issued since publication

Amd. No.	Date	Comments

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National foreword

This Part of BS 5944 has been prepared under the direction of the Machinery and Components Standards Policy Committee. It is identical with ISO 4412-2:1991 *Hydraulic fluid power — Test code for determination of airborne noise levels — Part 2: Motors*, published by the International Organization for Standardization (ISO).

On publication of BS 5944-1:1992 and BS 5944-2:1992, the 1980 editions of BS 5944-1, BS 5944-2 and BS 5944-3 will be withdrawn.

BS 5944 comprises the following Parts.

- *Part 1: Method of test for pumps;*
- *Part 2: Method of test for motors;*
- *Part 3: Withdrawn;*
- *Part 4: Method of determining sound power levels from valves controlling flow and pressure;*
- *Part 5: Simplified method of determining sound power levels from pumps using an anechoic chamber;*
- *Part 6: Method of test for pumps using parallelepiped microphone array.*

For the purposes of the British Standard the identification statement required by clause 13 may be replaced by the following:

“Airborne noise levels determined in accordance with BS 5944-2”

Cross-references

International Standard	Corresponding British Standard
ISO 3019-2:1986	BS 6276:1987 <i>Specification for dimensions and identification code for mounting flanges and shaft ends for hydraulic fluid power pumps and motors</i> (Technically equivalent)
ISO 3488:1975	BS 4231:1982 <i>Classification for viscosity grades of industrial liquid lubricants</i> (Identical)
	BS 4196 <i>Sound power levels of noise sources</i>
ISO 3744:1981	Part 4:1981 <i>Engineering methods for determination of sound power levels for sources in free-field conditions over a reflecting plane</i> (Identical)
ISO 3745:1977	Part 5:1981 <i>Precision methods for determination of sound power levels for sources in anechoic and semi-anechoic rooms</i> (Identical)
ISO 6743-4:1982	BS 6413 <i>Lubricants, industrial oils and related products (Class L)</i> Part 4:1983 <i>Classification for family H (hydraulic systems)</i> (Identical)
IEC 50(801):1984	BS 4727 <i>Glossary of electrotechnical, power, telecommunication, electronics, lighting, and colour terms</i> Part 3: Group 08:1985 <i>Acoustics and electroacoustics terminology</i> (Technically equivalent)
IEC 651:1979	BS 5969:1981 <i>Specification for sound level meters</i> (Identical)

The Technical Committee has reviewed the provisions of ISO 2204:1979 and ISO 5598:1985 to which reference is made in the text and has decided that they are acceptable for use in conjunction with this standard.

There are no corresponding British Standards for ISO 2204 or ISO 5598.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 16, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

Introduction

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

The airborne noise level of a hydraulic fluid power motor is an important consideration in component selection. The noise measurement technique must, 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 vibrations from the motor can be transmitted to the circuit and ultimately give rise to background airborne noise levels which could affect the determination of the motor airborne noise levels. The procedures described in this part of ISO 4412 are intended to measure only the airborne noise radiated directly from the motor under test.

1 Scope

This part of ISO 4412 establishes a test code describing procedures, based on ISO 2204, for the determination of the sound power levels of a hydraulic fluid power motor, under controlled conditions of installation and operation, suitable for providing a basis for comparing the noise levels of motors in terms of:

- A-weighted sound power level;
- octave band sound power levels.

From these sound power levels, if required, reference sound pressure levels may be calculated for reporting purposes in accordance with Annex A.

For general purposes, the frequency range of interest includes the octave bands with centre frequencies between 125 Hz and 8 000 Hz.¹⁾

Due to the inherent difficulties in the measurement of low-speed motor performance, this part of ISO 4412 is limited to motors operating at speeds exceeding 50 r/min.

Guidelines for the application of this part of ISO 4412 are given in Annex C.

This part of ISO 4412 is applicable to all types of hydraulic fluid power motors operating under steady-state conditions, irrespective of size, except for any limitations imposed by the size of the test environment (see clause 5).

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

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 50(801):1984, *International Electrotechnical Vocabulary — Chapter 801: Acoustics and electroacoustics*.

IEC 651:1979, *Sound level meters*.

3 Definitions

For the purposes of this part of ISO 4412, the definitions given in ISO 5598, IEC 50 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 a reflecting plane

field produced by a source in the presence of one reflecting plane on which the source is located

3.3 reverberant sound field

that portion of the sound field in a test room over which the influence of sound received directly from the source is negligible

¹⁾ 1 Hz = 1 s⁻¹

3.4
anechoic room

a 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

3.5
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.

3.6
mean sound pressure level

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 µPa²⁾.

3.7
sound power level

ten times the logarithm to the base 10 of the ratio of a given sound power to the reference sound power, in decibels

NOTE 4 The weighting network or the width of the frequency band used should always be indicated. The reference sound power is 1 pW³⁾.

3.8
volume of source under test

volume of the envelope of the whole motor under test

4 Measurement uncertainty

Methods of measurement should be used which tend to result in standard deviations which are equal to or less than those specified in Table 1. Methods given in ISO 3744 meet this requirement.

Table 1 — Standard deviation of sound power level determinations

Standard deviation, dB, for octave bands centred on:				
125 Hz	250 Hz	500 Hz	1 000 Hz to 4 000 Hz	8 000 Hz
5,0	3,0	2,0	2,0	3,0

2) 1 µPa = 10⁻⁶ N/m²
3) 1 pW = 10⁻¹² W

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 which provides “free-field over a reflecting plane” or “special reverberant” conditions which meet the environmental qualification requirements described in ISO 3744:1981, clause 4 and Annex A.

For more precise measurements, conduct tests in accordance with ISO 3745.

6 Instrumentation

6.1 The instrumentation used to measure fluid flow, fluid pressure, motor speed and fluid temperature shall be in accordance with the recommendations for “industrial class” accuracy of testing; i.e. class C given in Annex B.

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.

7 Installation conditions

7.1 Motor location

The motor may be located in any position consistent with the source installation and measurement surface (or microphone traverse) requirements specified in ISO 3744 for the test environment being used.

7.2 Motor mounting

7.2.1 The motor mounting shall be constructed so that it will minimize the noise radiated by the mounting as a result of motor vibrations.

7.2.2 The mounting bracket shall be constructed of high-damping material or with sound-damping and sound-insulating material applied to the bracket as required.

7.2.3 Vibration isolation techniques, if needed, shall be used even if the motor is usually securely mounted.