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Hydraulic fluid power — Determination of the fluid-borne noise characteristics of components and systems —

Part 2: Measurement of the speed of sound in a fluid in a pipe

Transmissions hydrauliques — Évaluation des caractéristiques du bruit liquidien des composants et systèmes —

Partie 2: Mesurage de la vitesse du son émis dans un fluide dans une tuyauterie

Reference number
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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 131, *Fluid power systems*, Subcommittee SC 8, *Product testing*.

This second edition cancels and replaces the first edition (ISO 15086-2:2000), which has been technically revised.

The main changes are as follows:

— the frequency range of pressure ripples has been revised;

— the symbol units, the symbol B_e, subscript O and N have been added to Table 1;

— the symbol f_0 (first acoustic antiresonance frequency) has been replaced by f_{a1};

— Figures 3 and C.1 have been added;

— Figures 1, 2 and 4 have been corrected;

— Formulae 1, C.2, and C.3 have been corrected;

— Annex D has been revised;

— various additional editorial modifications have been made.

A list of all parts in the ISO 15086 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Introduction

In hydraulic fluid power systems, power is transmitted and controlled through a liquid under pressure within an enclosed circuit. During the process of converting mechanical power into hydraulic fluid power, flow and pressure ripple and structure-borne vibrations are generated.

Hydro-acoustical characteristics of hydraulic components can be measured with acceptable accuracy if the speed of sound in the fluid is precisely known.

The measurement technique for determining the speed of sound in a pipe, as described in this document, is based upon the application of plane wave transmission line theory to the analysis of pressure ripple in rigid pipes[1].

Two different measurement approaches are presented, namely the use of

— three pressure transducers in a pipe, and

— acoustic antiresonance in a closed-end pipe system.

The three-pressure-transducer method should be used at any time when the speed of sound is to be measured under the effective working conditions in a system. This method can be performed simultaneously with the hydro-acoustical measurement methods specified in ISO 10767-1, ISO 10767-3 and ISO 15086-3, using the same equipment and measurements.

Either method is suitable to produce a table of speed-of-sound data as a function of mean pressure and temperature for a particular fluid.

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Hydraulic fluid power — Determination of the fluid-borne noise characteristics of components and systems —

Part 2: Measurement of the speed of sound in a fluid in a pipe

1 Scope

This document describes the procedure for the determination of the speed of sound in a fluid enclosed in a pipe, by measurements from pressure transducers mounted in the pipe.

This document is applicable to all types of hydraulic circuit operating under steady state conditions, irrespective of size, for pressure pulsations over a frequency range from 10 Hz to 3 kHz.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

ISO 5598, *Fluid power systems and components — Vocabulary*

ISO 80000-1, *Quantities and units — Part 1: General*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 5598 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
flow ripple
fluctuating component of flowrate in a hydraulic fluid, caused by interaction with a flow ripple source within the system

3.2
pressure ripple
fluctuating component of pressure in a hydraulic fluid, caused by interaction with a *flow ripple* (3.1) source within the system

3.3
fundamental frequency
lowest frequency of *pressure ripple* (3.2) measured by the frequency-analysis instrument

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