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

Part 3: Measurement of hydraulic impedance

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

Partie 3: Mesurage de l'impédance hydraulique

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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

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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 documents 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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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 15086-3:2008), which has been technically revised.

The main changes are as follows:

— the symbols P_y, y, $Q_{3\to x}$ and $Q_{3\to 0}$ have been added to Table 1;

— Formula (7) has been added;

— Formulae (3), (8), (13), (14), (16) and (17) have been corrected;

— Figures 1, 2, 3, 5, 6, 7 and 8 have been corrected;

— 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 a closed circuit. During the process of converting mechanical power into fluid power, fluid-borne noise (flow ripple and pressure ripple) is generated. This in turn leads to structure-borne noise and airborne noise. The transmission of fluid-borne noise is influenced by the impedance of the components installed in the hydraulic circuit.

This document adopts the concepts of ISO 15086-1 which describe the basis for the methods of measurement that make it possible to determine the characteristics of fluid-borne noise emitted or transmitted by hydraulic transmission systems.

Clause 6 of this document describes the method for measuring the hydraulic impedance of a single-port component (local hydraulic impedance) and Clause 7 describes the method for measuring the hydraulic impedance matrix of a two-port hydraulic component.

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

Part 3:
Measurement of hydraulic impedance

1 Scope

This document describes the procedure for determining the impedance characteristics of hydraulic components by means of measurements from pressure transducers mounted in a pipe.

This document is applicable to passive components, irrespective of size, operating under steady-state conditions, 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 80000-1, *Quantities and units — Part 1: General*

ISO 1219-1, *Fluid power systems and components — Graphical symbols and circuit diagrams — Part 1: Graphical symbols for conventional use and data-processing applications*

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

ISO 15086-1:2001, *Hydraulic fluid power — Determination of the fluid-borne noise characteristics of components and systems — Part 1: Introduction*

ISO 15086-2:2000, *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*

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
fluctuation of flow rate in the hydraulic fluid

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

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3.3
pulse generator
hydraulic component generating a periodic *flow ripple* (3.1) and consequently *pressure ripple* (3.2) in a circuit, or a hydraulic component generating a pressure ripple and, consequently, a flow ripple in a circuit

3.4
fundamental frequency
lowest frequency of the *pressure ripple* (3.2) [or *flow ripple* (3.1)] considered in a theoretical analysis or measured by an instrument

EXAMPLE A hydraulic pump or motor with a shaft frequency of N revolutions per second can be taken to have a fundamental frequency of N Hz. Alternatively, for a pump or motor with k displacement elements, the fundamental frequency can be taken to be Nk Hz, provided that the measured behaviour does not deviate significantly from cycle to cycle.

3.5
harmonic
sinusoidal component of a signal that occurs at an integer multiple of the *fundamental frequency* (3.4)

Note 1 to entry: A harmonic can be represented by its amplitude and phase, or by its real and imaginary parts.

3.6
impedance
ratio of the *pressure ripple* (3.2) to the *flow ripple* (3.1) occurring at a given point in a hydraulic system and at a given frequency

3.7
admittance
reciprocal of *impedance* (3.6)

3.8
hydro-acoustic energy
fluctuating part of the energy in a liquid

4 Symbols

Table 1 — Symbols

Symbol	Description	Unit
A_e	complex coefficient (term of admittance matrix between transducer PT3 and component 0)	$m^3 \cdot s^{-1} \cdot Pa^{-1}$
A_x	complex coefficient (term of admittance matrix between transducers PTx and PT3)	$m^3 \cdot s^{-1} \cdot Pa^{-1}$
A_{xy}	terms of admittance matrix (for x and y equal to 1 or 2)	$m^3 \cdot s^{-1} \cdot Pa^{-1}$
B_e	complex coefficient (term of admittance matrix between transducer PT3 and component 0)	$m^3 \cdot s^{-1} \cdot Pa^{-1}$
B_x	complex coefficient (term of admittance matrix between transducers PTx and PT3)	$m^3 \cdot s^{-1} \cdot Pa^{-1}$
c	speed of sound in the fluid	$m \cdot s^{-1}$
f_{min}	minimum frequency	Hz
f_{max}	maximum frequency	Hz
H_{x3}	transfer function between pressure ripples P_x and P_3	—
L	distance between transducers	m
p_m	mean test pressure	MPa
P_e	Fourier transform of pressure ripple at upstream port of component	Pa

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