International Standard

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Hydraulic fluid power — Determination of pressure ripple levels generated in systems and components —

Part 3: Method for motors

Transmissions hydrauliques — Détermination des niveaux d'onde de pression engendrés dans les circuits et composants —

Partie 3: Méthode pour les moteurs

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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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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 10767-3:1999), which has been technically revised.

The main changes are as follows:

— the upper limit of 400 Hz on motoring frequency has been removed;

— spacing between pressure transducers has been increased for method 2 (5.5.6);

— a detailed procedure is given for frequency analysis (B.3);

— modelling of source impedance has been replaced with linear interpolation of source reflection coefficient (8.5.4);

— additional rating quantities are included: anechoic flow ripple (8.6) and anechoic power (8.7), to replace anechoic pressure ripple;

— extensive editorial changes have been made, to aid clarity and avoid ambiguity.

A list of all parts in the ISO 10767 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. Positive displacement motors are components that convert hydraulic fluid power into rotary mechanical power. During the process of converting hydraulic power into rotary power, flow and pressure ripple and structure-borne vibrations are generated.

The pressure ripple and the structure-borne vibrations, which are generated by the unsteady flow drawn in by the motor are transmitted through the system at levels depending upon the characteristics of the motor and the circuit. Thus, the determination of the pressure ripple generated by a motor is complicated by the interaction between the motor and the circuit. The method adopted to measure the pressure ripple levels of a motor should, therefore, be such as to eliminate this interaction.

The measurement technique described in this document isolates the motor flow ripple and pressure ripple from the effects of such circuit interactions, by mathematical processing of pressure ripple measurements (see References [4] to [11]). A figure of merit is obtained which allows motors of different types and manufacturer to be compared as pressure ripple generators. This enables the motor designer to evaluate the effect of design modifications on the pressure ripple levels produced by the motor in service. It also enables the hydraulic system designer to avoid selecting motors having high pressure ripple levels.

Results are produced from this document in different forms, including amplitude and phase spectra and single figures of merit, as the following:

a) the source flow ripple amplitude, in m^3/s, and phase, in degrees, up to the tenth harmonic of motoring frequency or 3,5 kHz, whichever is the lower;

b) the source impedance amplitude, in $(Pa \cdot s)/m^3$, and phase, in degrees, up to the tenth harmonic of motoring frequency or 3,5 kHz, whichever is the lower;

c) anechoic flow ripple amplitude, in m^3/s, and phase, in degrees, up to the tenth harmonic of motoring frequency or 3,5 kHz, whichever is the lower;

d) the time history wave form of the anechoic flow ripple, in m^3/s;

e) the anechoic power, in watts, up to the tenth harmonic of motoring frequency or 3,5 kHz, whichever is the lower;

f) the overall anechoic power, in watts;

g) the blocked acoustic pressure ripple amplitude, in pascals, up to the tenth harmonic of motoring frequency or 3,5 kHz, whichever is the lower;

h) the overall root mean square (RMS) blocked acoustic pressure ripple, in pascals.

A description of the different forms of rating and their purpose is given in Annex D.

The method is based upon the application of plane wave transmission line theory to the analysis of pressure ripple in hydraulic systems[12]. By evaluating the impedance characteristics of the circuit into which the motor is installed and the impedance of the motor itself, it is possible to isolate the source flow ripple and pressure ripple of the motor from the interactions of the circuit. The impedance characteristics of the circuit can be evaluated by analysis of pressure ripple measurements at two or more positions along a pipe, where the pipe is connected to the inlet port of the motor. However, to characterize the impedance of the system completely, it is not sufficient to measure the pressure ripple generated by the motor alone, as insufficient information is available for the impedance of the motor to be evaluated. The secondary-source method uses another source of pressure ripple at the opposite end of the supply line. The measurement of this pressure ripple enables the motor source impedance to be evaluated. Sufficient information is then available to evaluate the source flow ripple and pressure ripple of the motor.

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Hydraulic fluid power — Determination of pressure ripple levels generated in systems and components —

Part 3: Method for motors

1 Scope

This document specifies a procedure for the determination of a rating of the source flow ripple, source impedance and pressure ripple levels generated by positive-displacement hydraulic motors, including bidirectional motors.

This document is applicable to all types of positive-displacement motor operating under steady-state conditions, irrespective of size, for frequencies from 50 Hz to 3 500 Hz. It is applicable for the inlet port of positive-displacement motors.

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*

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 flow rate in the hydraulic fluid

3.2
pressure ripple
fluctuating component of pressure in the hydraulic fluid

3.3
impedance
complex 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

3.4
“Norton” model
representation of a source consisting of a *flow ripple* (3.1) in parallel with an *impedance* (3.3)

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