INTERNATIONAL STANDARD

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

Part 1:
Precision method for pumps

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

Partie 1: Méthode de précision pour les pompes

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Contents

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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 10767-1 was prepared by Technical Committee ISO/TC 131, *Fluid power systems*, Subcommittee SC 8, *Product testing and contamination control*.

ISO 10767 consists of the following parts, under the general title *Hydraulic fluid power — Determination of pressure ripple levels generated in systems and components*:

— *Part 1: Precision method for pumps*

— *Part 2: Simplified method for pumps*

— *Part 3: Method for motors*

Annexes A and B form an integral part of this part of ISO 10767. Annexes C and D are for information only.

Introduction

In hydraulic fluid power systems, power is transmitted and controlled through a liquid under pressure within an enclosed circuit. Positive-displacement pumps are components that convert rotary mechanical power into hydraulic fluid power. During the process of converting mechanical power into hydraulic power, flow and pressure fluctuations and structure-borne vibrations are generated.

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

The measurement technique described in this part of ISO 10767 isolates the pump flow and/or pressure ripple from the effects of such circuit interactions, by mathematical processing of pressure ripple measurements (see refs. [1] to [8]). A figure of merit for the pump is obtained which allows pumps of different types and manufacture to be compared as pressure ripple generators. This will enable the pump designer to evaluate the effect of design modifications on the pressure ripple levels produced by the pump in service. It will also enable the hydraulic system designer to avoid selecting pumps having high pressure ripple levels.

The method is based upon the application of plane wave transmission line theory to the analysis of pressure fluctuations in hydraulic systems [9]. By evaluating the impedance characteristics of the circuit into which the pump discharges and the impedance of the pump itself, it is possible to isolate the source flow ripple and/or pressure ripple of the pump 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 discharge port of the pump. However, to characterize the impedance of the system completely, it is not sufficient to measure the pressure ripple generated by the pump alone, as insufficient information is available for the impedance of the pump to be evaluated. The secondary-source method uses another source of pressure ripple at the opposite end of the discharge line. The measurement of this pressure ripple enables the pump source impedance to be evaluated. Sufficient information is then available to evaluate the source flow ripple and pressure ripple of the pump.

Because of the complexity of the analysis, data processing is preferably carried out using a digital computer. Suitable software packages are available from two sources (see annex C).

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

Part 1:
Precision method for pumps

1 Scope

This part of ISO 10767 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 pumps. Ratings are obtained as the following:

a) the source flow ripple amplitude, in litres per second, over ten individual harmonics of pumping frequency;

b) the source impedance amplitude, in newton seconds per metre to the power of five [$(N \cdot s)/m^5$], and phase, in degrees, over ten individual harmonics of pumping frequency;

c) the anechoic pressure ripple amplitude, in bars[1], over ten harmonics of pumping frequency;

d) the overall r.m.s. anechoic pressure ripple, in bars;

e) the blocked acoustic pressure ripple amplitude, in bars, over ten harmonics of pumping frequency;

f) the overall r.m.s. blocked acoustic pressure ripple, in bars.

This part of ISO 10767 is applicable to all types of positive-displacement pump operating under steady-state conditions, irrespective of size, provided that the pumping frequency is in the range from 50 Hz to 400 Hz.

1) 1 bar = 10^5 Pa = 10^5 N/m^2

2 Definitions

For the purposes of this part of ISO 10767, the following definitions apply.

2.1 source flow ripple: Fluctuating component of flowrate generated within the pump, which is independent of the characteristics of the connected circuit.

2.2 flow ripple: Fluctuating component of flowrate in the hydraulic fluid, caused by interaction of the source flow ripple with the system.

2.3 pressure ripple: Fluctuating component of pressure in the hydraulic fluid, caused by interaction of the source flow ripple with the system.

2.4 anechoic pressure ripple: Pressure ripple that would be generated at the pump discharge port when discharging into an infinitely long rigid pipe of the same internal diameter as the pump discharge port.

2.5 blocked acoustic pressure ripple: Pressure ripple that would be generated at the pump discharge port when discharging into a circuit of infinite impedance.

2.6 impedance: Complex ratio of the pressure ripple to the flow ripple occurring at a given point in a hydraulic system and at a given frequency.