

Implementation of  
ISO 10767-1:1996

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

Part 1: Precision method for pumps

ICS 23.100.10

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The preparation of this British Standard was entrusted to Technical Committee MCE/18, upon which the following bodies were represented:

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

This British Standard, having been prepared under the direction of the Engineering Sector Board, was published under the authority of the Standards Board and comes into effect on 15 September 1996

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The following BSI references relate to the work on this standard:  
Committee reference MCE/18  
Draft for comment 93/716429 DC

ISBN 0 580 26048 8

## Amendments issued since publication

| Amd. No. | Date | Comments |
|----------|------|----------|
|          |      |          |
|          |      |          |
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## National foreword

This British Standard reproduces verbatim ISO 10767-1:1996 and implements it as the UK national standard. It supersedes BS 6335-1:1990 which is withdrawn. This British Standard is published under the direction of the Engineering Sector Board whose Technical Committee MCE/18 has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible international committee any enquiries on interpretation, or proposals for change, and keep UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

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### Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, the ISO title page, pages ii to iv, pages 1 to 18, 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.

INTERNATIONAL  
STANDARD

**ISO**  
**10767-1**

First edition  
1996-04-01

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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*



Reference number  
ISO 10767-1:1996(E)

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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).

## 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  $[(N\ s)/m^5]$ , and phase, in degrees, over ten individual harmonics of pumping frequency;
- c) the anechoic pressure ripple amplitude, in bars<sup>1)</sup>, 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.

<sup>1)</sup> 1 bar =  $10^5$  Pa =  $10^5$  N/m<sup>2</sup>