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**Hydraulic fluid power — Fluid  
contamination — Determination of  
particulate contamination by the counting  
method using an optical microscope**

*Transmissions hydrauliques — Pollution des fluides — Détermination de la  
pollution particulaire par comptage au microscope optique*



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Printed in Switzerland

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

The main task of technical committees is to prepare International Standards. 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.

Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 4407 was prepared by Technical Committee ISO/TC 131, *Fluid power systems*, Subcommittee SC 6, *Contamination control and hydraulic fluids*.

This second edition cancels and replaces the first edition (ISO 4407:1991), which has been technically revised.

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## Introduction

In hydraulic fluid power systems, power is transmitted and controlled through a liquid under pressure within an enclosed circuit. The liquid is both a lubricant and power transmitting medium.

The presence of particulate contamination in the liquid interferes with its ability to lubricate and causes wear to the components. The level of contamination in the liquid has a direct bearing on the performance and reliability of the system, and should be controlled to a level appropriate for the system concerned.

Quantitative determination of particulate contamination requires precision in obtaining a representative sample of the liquid and in determining the level of contamination. The method of particle counting using the optical microscope is an accepted means of determining the extent of contamination. The accuracy of particle count data can be affected by the techniques used.

This International Standard details procedures for the separation of particles in liquid samples by vacuum filtration and subsequent analysis of the particles deposited on an analytical membrane filter by microscopic techniques. The techniques involve counting using transmitted or incident light both manually and using image analysis techniques. This International Standard specifies methods to ensure accurate and consistent results.

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# Hydraulic fluid power — Fluid contamination — Determination of particulate contamination by the counting method using an optical microscope

**WARNING** — The use of this International Standard may involve hazardous materials, operations and equipment. This International Standard does not purport to address all the safety problems associated with its use. It is the responsibility of the user of this International Standard to establish appropriate safety and health practices and determine the applicability of regulative limitations prior to use.

## 1 Scope

This International Standard specifies methods for determining the level of particulate contamination in liquids used in hydraulic systems by counting the number of particles deposited on the surface of a membrane filter using an optical microscope. It includes particle counting by two manual methods and image analysis, using either transmitted or incident lighting systems.

Particle sizes  $\geq 2 \mu\text{m}$  can be sized and counted by this method, but the resolution and accuracy of the results will depend upon the optical system used and the capabilities of the operator.

All hydraulic fluids with a wide range of contamination levels can be analysed according to this International Standard. However, the counting uncertainty at the larger particle sizes increases if the volume filtered is reduced to allow smaller sized particles to be counted, where a fine precipitate or a high particle concentration is present.

## 2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 3722, *Hydraulic fluid power — Fluid sample containers — Qualifying and controlling cleaning methods*

ISO 4406:1999, *Hydraulic fluid power — Fluids — Method for coding the level of contamination by solid particles*

ISO 4788, *Laboratory glassware — Graduated measuring cylinders*

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

ISO 14644-1:1999, *Cleanrooms and associated controlled environments — Classification of air cleanliness*