



**International
Standard**

ISO 4407

**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*

**Third edition
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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 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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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 system*, Subcommittee SC 6, *Contamination control*.

This third edition cancels and replaces the second edition (ISO 4407:2002) which has been technically revised.

The main changes are as follows:

- more detailed procedure for automated particle counting by image analysing software.

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.

Introduction

Fluids are used for a multitude of reasons over an array of industries. Whether they are used for hydraulic power, lubricating or operational fluids, the presence of particulate contamination adversely affects the fluids properties. This reduces the fluids capabilities and performance that can lead to damage of components, equipment and eventual system failure.

The level of contamination in a fluid has a direct impact upon its performance and reliability.

Quantitative determination of particulate contamination requires precision in obtaining a representative sample of the fluid to accurately ascertain the level of contamination. The method of particle counting using an optical microscope is an accepted means of determining the extent of contamination. The accuracy of particle counting can be affected by the different techniques and methods used. The accuracy when using the automated method described in this document is typically in a range of +/- one ISO code according to ISO 4406.

This document details procedures that are acceptable methods for each step of the process of removing particulate contamination from a fluid for analysis to achieve a uniform method, both manual and automated, for particle counting. These steps include sample preparation, vacuum filtration, filter membrane preparation and, both manual and automated counting methods.

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

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

1 Scope

This document specifies acceptable methods for determining the level of particulate contamination in a known volume of fluid used in power systems by counting the number of particles captured on the surface of a filter membrane using an optical microscope. It includes accepted methods of particle counting utilising image analysis software or manual counting.

The aim of this document is to regulate a uniform, non-subjective filter membrane method of particle counting that will ensure that the classification standard result is achieved by analysing, where feasible, the entire effective filtration area (EFA) of the filter membrane.

The resolution and accuracy of the results will be dependent upon the optical system used, whether image capture analysis software is used, and when opting for the manual counting method, the capabilities of the operator.

All fluids that can be successfully vacuumed through the appropriate pore sized filter membrane will be able to use the following 2 methods of membrane filter analysis:

- Automated counting (see [Annex A](#)): automated detection, size classification and counting of particles on a membrane filter by using an optical microscope and image analysing software.
- Manual counting (see [Annex B](#)): manual detection, size classification and counting of particles on a membrane filter using an optical microscope.

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

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/>