



SLOVENSKI STANDARD SIST ISO 4407:2003

01-julij-2003

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

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

iTeh STANDARD PREVIEW

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

[SIST ISO 4407:2003](https://standards.iteh.ai/catalog/standards/sist/26647fa0-aa98-4d8b-8066-07c1153b309f/sist-iso-4407-2003)

Ta slovenski standard je istoveten z: **ISO 4407:2002**

ICS:

23.100.60

Filters, seals and contamination of fluids

Filters, seals and contamination of fluids

SIST ISO 4407:2003

en

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[SIST ISO 4407:2003](#)

<https://standards.iteh.ai/catalog/standards/sist/26647fa0-aa98-4d8b-8066-07cf133b309f/sist-iso-4407-2003>

INTERNATIONAL
STANDARD

ISO
4407

Second edition
2002-04-15

**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*

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[SIST ISO 4407:2003](https://standards.iteh.ai/catalog/standards/sist/26647fa0-aa98-4d8b-8066-07cfl33b309f/sist-iso-4407-2003)

<https://standards.iteh.ai/catalog/standards/sist/26647fa0-aa98-4d8b-8066-07cfl33b309f/sist-iso-4407-2003>



Reference number
ISO 4407:2002(E)

© ISO 2002

ISO 4407:2002(E)

PDF disclaimer

This PDF file may contain embedded typefaces. In accordance with Adobe's licensing policy, this file may be printed or viewed but shall not be edited unless the typefaces which are embedded are licensed to and installed on the computer performing the editing. In downloading this file, parties accept therein the responsibility of not infringing Adobe's licensing policy. The ISO Central Secretariat accepts no liability in this area.

Adobe is a trademark of Adobe Systems Incorporated.

Details of the software products used to create this PDF file can be found in the General Info relative to the file; the PDF-creation parameters were optimized for printing. Every care has been taken to ensure that the file is suitable for use by ISO member bodies. In the unlikely event that a problem relating to it is found, please inform the Central Secretariat at the address given below.

iTeh STANDARD PREVIEW (standards.iteh.ai)

[SIST ISO 4407:2003](https://standards.iteh.ai/catalog/standards/sist/26647fa0-aa98-4d8b-8066-07cfl33b309f/sist-iso-4407-2003)

<https://standards.iteh.ai/catalog/standards/sist/26647fa0-aa98-4d8b-8066-07cfl33b309f/sist-iso-4407-2003>

© ISO 2002

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.ch
Web www.iso.ch

Printed in Switzerland

Contents

Page

Foreword.....	iv
Introduction.....	v
1 Scope	1
2 Normative references	1
3 Terms and definitions	2
4 Counting principle	4
5 Apparatus	4
6 Reagent and chemicals.....	6
6.1 Reagent and rinsing and cleaning chemicals	6
6.2 Liquids for transparentizing the membrane filter (transmitted-light method)	6
7 Glassware cleaning procedure	6
8 Calibration procedures	6
8.1 Microscope calibration.....	6
8.2 Determination of Effective Filtration Area (EFA)	7
9 Membrane filter preparation	7
9.1 Sample preparation	7
9.2 Blank analysis.....	8
9.3 Separation of contaminants by vacuum filtration.....	8
9.4 Evaluation of suitability for counting.....	9
9.5 Mounting of membrane filters for observation under transmitted light	10
10 Particle sizing and counting procedure	10
10.1 Particle sizing.....	10
10.2 Selection of nominal magnification	10
10.3 Statistical counting procedure.....	10
10.4 Calculation of total count.....	11
10.5 Verification of data	12
11 Expression of results	13
12 Identification statement (Reference to this International Standard).....	13
Bibliography.....	14

ISO 4407:2002(E)

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.

iTeh STANDARD PREVIEW
(standards.iteh.ai)

SIST ISO 4407:2003
<https://standards.iteh.ai/catalog/standards/sist/26647fa0-aa98-4d8b-8066-07cfl33b309f/sist-iso-4407-2003>

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.

iTeh STANDARD PREVIEW (standards.iteh.ai)

[SIST ISO 4407:2003](https://standards.iteh.ai/catalog/standards/sist/26647fa0-aa98-4d8b-8066-07cfl33b309f/sist-iso-4407-2003)

<https://standards.iteh.ai/catalog/standards/sist/26647fa0-aa98-4d8b-8066-07cfl33b309f/sist-iso-4407-2003>

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[SIST ISO 4407:2003](#)

<https://standards.iteh.ai/catalog/standards/sist/26647fa0-aa98-4d8b-8066-07cf133b309f/sist-iso-4407-2003>

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*

ISO 4407:2002(E)

3 Terms and definitions

For the purposes of this International Standard, the definitions given in ISO 5598 and the following apply.

3.1

blank count

count resulting from contaminants introduced from other sources, such as reagents, cleaning of glassware and preparation of the membrane filter (see 9.2)

3.2

calculation factor

ratio of the effective filtration area to the total area counted

3.3

effective filtration area

EFA

circular area of the membrane filter open to flow during filtration of liquid

NOTE Both the effective filtration area (EFA) and the effective filtration diameter (EFD) are determined in 8.2.

3.4

fibre

particle longer than 100 µm with a length-to-width ratio greater than or equal to 10:1

3.5

fixative liquid

liquid that, as a result of a heat curing process, causes a membrane filter to adhere to a glass base slide, resulting in an opaque residue

iTeh STANDARD PREVIEW
(standards.iteh.ai)

3.6

grid square

square with sides of nominally 3,1 mm printed on membrane filters

SIST ISO 4407:2003

<https://standards.iteh.ai/catalog/standards/sist/26647fa0-aa98-4d8b-8066-07c115383091/sist-iso-4407-2003>

NOTE Gridded membrane filters may not be suitable for counting using image analysis techniques.

3.7

image analyser

instrumentation to automatically size and count particles deposited on a membrane filter

NOTE A video image of the particle is digitally recreated based upon the difference in the grey scale contrast of the particle and background, and the size is automatically computed. Sizing of the particle can also be undertaken on the video screen.

3.8

mountant liquid

liquid that, when heated, causes a membrane filter, previously treated with fixative liquid, to become transparent and to adhere to the cover slip (see 5.7)

3.9

particle size

size of particle as defined by the particle's longest dimension

3.10

solvent

liquid that is physically and chemically compatible with and miscible in the sample liquid

NOTE A solvent is used for diluting the sample liquid, and can be used for cleaning and rinsing the apparatus. The solvent should be chemically compatible with the apparatus, especially the membrane filter, and should not dissolve the particles.

3.11**statistical counting**

counting and sizing particles using a proportion of the membrane filter's surface, whereby at least 150 particles are counted over a total of at least 10 separate locations (fields)

NOTE 1 Statistical counting requires an even distribution of particles over the complete surface, and membrane filters should be rejected for counting if this is not achieved.

NOTE 2 Counting 150 particles gives a counting uncertainty of 8 %, and the counting uncertainty will be reduced if more particles are counted.

3.12**unit area**

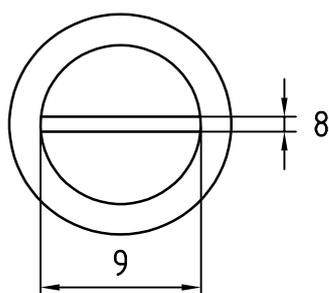
proportion of membrane filter that is counted for statistical purposes

NOTE For manual counting, the unit area is defined as the area of the membrane filter bound in the horizontal plane by two adjacent vertical membrane filter grid lines and in the vertical plane by two parallel lines either on the ocular micrometer eyepiece or drawn on a projection screen. Examples are given in Figure 1. For image analysis, this is a fixed field of view defined by the optical and electronic systems.



SIST ISO 4407:2003

<https://standards.itech.ai/catalog/standards/sist/26647fa0-aa98-4d8b-8066-07cfl33b309f/sist-iso-4407-2003>

**Key**

- 1 Grid square
- 2 Width of grid square (mm)
- 3 Length of grid square (mm)
- 4 Full grid square
- 5 Unit area on a gridded membrane
- 6 Graticule height used for defining unit area (μm)
- 7 Unit area
- 8 Diametric unit area on ungridded membrane
- 9 Effective filtration diameter of membrane

Figure 1 — Examples of unit areas