



**SLOVENSKI STANDARD**  
**SIST ISO 4405:2023**

**01-april-2023**

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**Fluidna tehnika - Hidravlika - Onesnaženje fluidov - Ugotavljanje onesnaženosti z delci - Gravimetrijska metoda**

Hydraulic fluid power - Fluid contamination - Determination of particulate contamination by the gravimetric method

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Transmissions hydrauliques - Pollution des fluides - Détermination de la pollution particulaire par la méthode gravimétrique

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**Ta slovenski standard je istoveten z: ISO 4405:2022**

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**ICS:**

23.100.60

Filtri, tesnila in  
onesnaževanje tekočin

Filters, seals and  
contamination of fluids

**SIST ISO 4405:2023**

**en,fr,de**



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**Hydraulic fluid power — Fluid  
contamination — Determination of  
particulate contamination by the  
gravimetric method**

*Transmissions hydrauliques — Pollution des fluides — Détermination  
de la pollution particulaire par la méthode gravimétrique*

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Phone: +41 22 749 01 11  
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## ISO 4405:2022(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.

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 documents 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](http://www.iso.org/directives)).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see [www.iso.org/patents](http://www.iso.org/patents)).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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](http://www.iso.org/iso/foreword.html).

This document was prepared by Technical Committee ISO/TC 131, *Fluid power systems*, Subcommittee SC 6, *Contamination control*.

This second edition cancels and replaces the first edition (ISO 4405:1991), which has been technically revised.

The main changes are as follows.

- The calibration and test equipment have been updated and reduced to the most essential parts.
- The single steps of the calibration and test procedure have been updated and adapted to achieve the most reliable and verifiable test results.
- The double-membrane method has been eliminated as the test results have proven to be less reliable than those obtained by the single-membrane method.

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](http://www.iso.org/members.html).

## 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 a power-transmitting medium.

Reliable system performance requires control of the fluid medium. Qualitative and quantitative determination of particulate contamination in the fluid medium requires precision in obtaining the sample and in determining the nature and extent of contamination.

The gravimetric method of determination of fluid contamination involves weighing suspended solids per unit volume of fluid. The method employs membrane filters, which maintain fluid cleanliness by removing insoluble particles.

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# Hydraulic fluid power — Fluid contamination — Determination of particulate contamination by the gravimetric method

## 1 Scope

This document defines the gravimetric method for determining the contamination level of fluids used in hydraulic fluid power systems.

The working instructions provided in this document serve for the gravimetric determination of dirt content of pressure fluids from mineral oil with additives. They are used in hydraulic systems with hydrostatic drive.

## 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 4021, *Hydraulic fluid power — Particulate contamination analysis — Extraction of fluid samples from lines of an operating system*

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

ISO 11158, *Lubricants, industrial oils and related products (class L) — Family H (hydraulic systems) — Specifications for categories HH, HL, HM, HV and HG*

## 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/>

### 3.1

#### hydraulic oil HH

non-inhibited mineral oil

### 3.2

#### hydraulic oil HL

oil of HH type with improved anti-rust and anti-oxidation properties

### 3.3

#### hydraulic oil HM

oil of HL type with improved anti-wear and filterability properties

### 3.4

#### hydraulic oil HV

oil of HM type with improved viscosity/temperature properties

**ISO 4405:2022(E)****3.5****hydraulic oil HG**

oil of HM type with improved anti-stick-slip properties

**4 Principle**

The gravimetric amount of contamination shall be determined by filtering a defined volume of fluid under vacuum conditions through one filter membrane. The increase in mass of the membrane after filtration represents the solid impurity content. This analytical method is suitable for dirt concentrations of 3 mg/l or greater and the hydraulic oils of categories: HH, HL, HM, HV, and HG, in accordance with ISO 11158. The room conditions should have a temperature between 20 °C and 30 °C and humidity between 30 % and 65 % relative humidity (RH).

**5 Test apparatus****5.1 Equipment**

- 1) One suction bottle made of glass.
- 2) Solvent dispenser rinsed and filled with filtered solvent - 0,2 µm (see [Figure C.1](#)).
- 3) PTFE seal (white) for stainless steel filter grid or glass frit (see [Figure C.2](#)).
- 4) Membrane holder funnel made of glass for the stainless steel filter grid (see [Figure C.3](#)).
- 5) Stainless steel filter grid or glass frit (see [Figure C.4](#) or [Figure C.5](#)).
- 6) Glass funnel.
- 7) Metal spring clip with electrical grounding and glass funnel (see [Figure C.6](#)).
- 8) Petri dish made of glass with lid (see [Figure C.7](#)).
- 9) Watch glass made of glass; diameter approximately 60 mm (see [Figure C.8](#)).
- 10) Exsiccator/desiccator with silica gel drying agent (with colour indicator), to operate without vacuum (see [Figure C.9](#)).
- 11) One 250 ml graduated cylinder for oil samples (see [Figure C.10](#)).
- 12) Vacuum pump with adjustable vacuum level.
- 13) Non-ventilated drying oven up to 100 °C.
- 14) Filter tweezers, stainless steel with smooth endings.
- 15) Solvent-proof gloves without powder inside.
- 16) Analytical balance (accuracy ±0,02 mg with five-digit display), the electrostatic conductivity between the weighting plate and the grounding of the power plug shall be given.
- 17) Clock accurate to the second.

For photos and description of the test equipment, see [Annex C](#).

**5.2 Filter membrane**

Filter membranes, of 47 mm diameter, white, non-gridded 0,8 µm pore size and compatible with the fluid to be analysed and with the rinsing chemicals can be used. Reference membranes have a 0,8 µm pore size. The material shall be made of cellulose acetate, for example, cellulose mixed ester

0,8 µm from Millipore (Type AAWP04700), Pall (Type GN4-08 µm Metrical MCE) or Sartorius (item name: Zelluloseacetat-Filter 0,8 µm) and for the gravimetric determination, the use of the membrane AAWP04700 from Millipore<sup>1)</sup>.

## 6 Rinsing and cleaning chemicals (Solvent)

The solvent to use is Petrol 40/65, petroleum ether 40/65 or 40/60 filtered through a 0,2 µm membrane filter. No other solvent is acceptable unless it is qualified in [Annex A](#).

NOTE It is useful to take hexane-free petrol, hexane is harmful to health.

**WARNING — Exercise care when using solvents which have low flash points. Appropriate precautions should also be taken to avoid inhalation of toxic fumes emanating from these solvents.**

## 7 Glassware cleaning procedure [determination of the cleanliness of the glass funnel and the graduated cylinder at the beginning (blank value)]

Before the operation, all the glassware shall be cleaned with filtered solvent. To determine the cleanliness, i.e. the blank value of the glass funnel and the graduated cylinder by the gravimetric analysis, proceed as follows.

- 1) Put one membrane onto the glass membrane holder funnel with the stainless steel filter grid or the glass frit. Apply vacuum and rinse (20-30) ml with solvent.
- 2) Remove the membrane and lay it on the watch glass. Lay the watch glass with the membrane in a suitable Petri dish and dry in the oven (half covered) at approximately 80 °C for a minimum of 10 min.
- 3) Subsequently put the watch glass with the membrane into the exsiccator/desiccator and let it cool down for a minimum of 10 min.
- 4) Take the watch glass out of the exsiccator/desiccator and lay the watch glass with the membrane in a suitable (half covered) Petri dish condition for approximately 10 min at room temperature. Weigh without watch glass. Record displayed value when value no longer changes.
- 5) Place the conditioned membrane on the glass membrane holder funnel with the stainless steel filter grid or glass frit. Attach the glass funnel.
- 6) Rinse the graduated cylinder with solvent. Transfer the rinsing volume into the filtration unit. Apply vacuum and begin the filtration. Reduce the vacuum to achieve a rinsing time of (50-100) ml solvent of at least 4 min. Rinse three times with approximately 10 % of the graduated cylinder volume. This procedure ensures that the oil is dissolved out of the membrane without leaving any residue.
- 7) Remove the glass funnel. Let the liquid drop onto the membrane, rinse carefully the edge of the filter membrane with fluid out of the solvent dispenser.
- 8) Place the membrane onto a labelled watch glass. Place the watch glass with the membrane in a suitable Petri dish and dry in the oven (half covered) at approximately 80 °C for a minimum of 10 min.
- 9) Subsequently, put the watch glass with the membrane into the exsiccator/desiccator and let them cool down for a minimum of 10 min.

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1) These are examples of suitable products available commercially. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of these products named. Equivalent products may be used if they can be shown to lead to the same results.