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Hydraulic fluid power — Determination of the particulate contamination level of a liquid sample by automatic particle counting using the light-extinction principle

Transmissions hydrauliques — Détermination du niveau de pollution particulaire d'un échantillon liquide par comptage automatique des particules par absorption de lumière

Reference number
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Contents

Page

Foreword ... **iv**
Introduction ... **v**
1 Scope ... **1**
2 Normative references ... **1**
3 Terms and definitions ... **1**
4 Materials and equipment ... **2**
5 Diluent liquid ... **3**
6 Pre-test requirements and procedures ... **4**
6.1 Precautions ... 4
6.1.1 Chemicals ... 4
6.1.2 Electrical interference ... 4
6.1.3 Use of magnetic stirrer ... 4
6.1.4 Relative humidity ... 4
6.1.5 Sample storage ... 4
6.2 Glassware cleaning procedure ... 4
6.3 APC calibration procedure ... 5
6.4 APC operation ... 5
6.5 Sample inspection and preparation before counting ... 5
6.5.1 Outline ... 5
6.5.2 Initial preparation and inspection ... 5
6.5.3 Preparation of sample of excessive volume ... 6
6.5.4 Determination of presence of water ... 7
6.6 Determination of need for sample dilution ... 7
7 Procedure for determining the particulate contamination level by automatic counting ... **7**
7.1 Outline ... 7
7.2 Sample dilution ... 8
7.2.1 Use of sample dilution ... 8
7.2.2 Precautions ... 9
7.2.3 Volumetric dilution method ... 9
7.2.4 Mass dilution method ... 10
7.3 Analysis procedure ... 10
8 Test report ... **12**
9 Identification statement (reference to this document) ... **13**
Annex A (normative) **Procedure for performing a statistical check of an automatic particle counter** ... **14**
Annex B (informative) **Acceptable diluents** ... **15**
Annex C (informative) **Method for pre-cleaning diluent and method for incorporating additives into the diluent to eliminate the influence of static electricity on particle counts** ... **16**
Annex D (informative) **Reporting particulate contamination level in a hydraulic liquid sample as determined by automatic counting** ... **18**
Bibliography ... **20**

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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 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).

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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 systems*, Subcommittee SC 6, *Contamination control*.

This third edition cancels and replaces the second edition (ISO 11500:2008), which has been technically revised.

The main changes are as follows:

— the cleanliness requirements for sample containers have been updated to match ISO 11171;

— the instructions for flushing and diluting solutions using propan-2-ol (2-propanol) and demineralised water have been removed;

— Annex E has been deleted.

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.

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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 a power-transmitting medium.

The presence of solid contaminant particles in the liquid interferes with the ability of the hydraulic fluid to lubricate and causes wear to the components. The extent of contamination in the fluid has a direct bearing on the performance and reliability of the system, and it is essential to control solid contaminant particles to levels that are considered appropriate for the system concerned.

A quantitative determination of particulate contamination involves precision in obtaining the sample and in determining the extent of contamination. The liquid automatic particle counter (APC), which works on the light-extinction principle, has become an accepted means of determining the extent of contamination. The accuracy of particle count data can be affected by the techniques used to obtain such data.

This document details procedures for the analysis of contaminated liquid samples using an automatic particle counter. Correct use of an automatic particle counter helps to reduce errors and enhances the accuracy of reproducibility in data.

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Hydraulic fluid power — Determination of the particulate contamination level of a liquid sample by automatic particle counting using the light-extinction principle

1 Scope

This document specifies an automatic particle counting procedure for determining the number and sizes of particles present in hydraulic-fluid bottle samples of clear, homogeneous, single-phase liquids using an automatic particle counter (APC) that works on the light-extinction principle.

This document is applicable to the monitoring of:

a) the cleanliness level of fluids circulating in hydraulic systems;

b) the progress of a flushing operation;

c) the cleanliness level of support equipment and test rigs;

d) the cleanliness level of packaged stock fluid.

NOTE Measurements can be made with particles suspended in the original liquid or in a sample of the liquid diluted with a compatible liquid when APC coincidence error limits are exceeded.

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

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

ISO 11171:2022, *Hydraulic fluid power — Calibration of automatic particle counters for liquids*

ASTM E694-18, *Standard specification for laboratory glass volumetric apparatus*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 5598, ISO 11171 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
dilution factor
state when the liquid sample is diluted, at which the multiplier coefficient is required to calculate the number concentration of particles contained in the original liquid sample

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3.2
dilution ratio
ratio of the amount of diluted liquid sample to the amount of the diluents added at the time of dilution

3.3
coincidence error limit
highest concentration of NIST RM 8632x that can be counted with an *automatic particle counter* (3.7) with an error of less than 5 % resulting from the presence of more than one particle in the *sensing volume* (3.5) at one time

[SOURCE: ISO 11171:2022, 3.5]

3.4
light extinction
reduction in intensity of a light beam passing through the sensing volume caused by the interaction of the light with single particles

Note 1 to entry: This is also known as light blockage or light obscuration.

3.5
sensing volume
portion of the illuminated region of the sensor through which the fluid stream passes and from which the light is collected by the optical system

[SOURCE: ISO 11171:2022, 3.3]

3.6
threshold noise level
minimum voltage setting of an *automatic particle counter* (3.7) at which the observed pulse-counting frequency does not exceed 60 counts/min due to electrical noise in the absence of flow in the *sensing volume* (3.5)

[SOURCE: ISO 11171:2022, 3.2]

3.7
automatic particle counter
APC
instrument that automatically:

a) senses individual particles suspended in a controlled volume of fluid using optical *light extinction* (3.4) or light scattering principles;

b) measures the size of particles;

c) sorts or compiles particles into size ranges;

d) counts particles in each size range;

e) reports the number of particles in each size range per unit volume; and

f) facilitates instrument calibration according to this document

[SOURCE: ISO 11171:2022, 3.1, modified — Note 1 to entry has been deleted.]

4 Materials and equipment

4.1 Automatic particle counter (APC) for liquids, with bottle sampler utilizing the light extinction principle with at least 8 channels that can be sent at various threshold settings calibrated in accordance with ISO 11171.

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