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Hydraulic fluid power — Filters — Multi-pass method for evaluating filtration performance of a filter element

Transmissions hydrauliques — Filtres — Évaluation des performances par la méthode de filtration en circuit fermé

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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).

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).

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.

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 16889:2008), which has been technically revised. It also incorporates the Amendment ISO 16889:2008/Amd 1:2018.

The main changes are as follows:

— deletion of Table 4 (previous references to Table 4 replaced by references to ISO 11943:2021, Table C.2);

— harmonization of conductivity levels with ISO 23369.

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

In hydraulic fluid power systems, one of the functions of the hydraulic fluid is to separate and lubricate the moving parts of the components. The presence of solid particulate contamination produces wear, resulting in loss of efficiency, reduced component life and subsequent unreliability.

A hydraulic filter is provided to control the number of particles circulating within the system to a level that is commensurate with the degree of sensitivity of the components to the contaminant and the level of reliability required by the users.

To enable the comparison of the relative performance of filters so that the most appropriate filter can be selected, it is necessary that test procedures be available. The performance characteristics of a filter are a function of the element (its medium and geometry) and the housing (its general configuration and seal design).

In practice, a filter is subjected to a continuous flow of contaminant entrained in the hydraulic fluid until some specified terminal differential pressure (relief-valve cracking pressure or differential-pressure indicator setting) is reached.

Both the length of operating time (prior to reaching terminal pressure) and the contaminant level at any point in the system are functions of the rate of contaminant addition (ingression plus generation rates) and the performance characteristics of the filter.

Therefore, it is necessary that a realistic laboratory test to establish the relative performance of a filter provide the test filter with a continuous supply of ingressed contaminant and allow the periodic monitoring of the filtration performance characteristics of the filter.

It is also necessary that the test provide an acceptable level of repeatability and reproducibility, and that a standard test contaminant, the ISO medium test dust (ISO MTD) in accordance with ISO 12103-1, be featured. This product has been shown to have a consistent particle-size distribution and is available worldwide. The filtration performance of the filter is determined by measurement of the upstream and downstream particle-size distributions using automatic particle counters validated according to ISO International Standards.

This test is intended to differentiate filter elements according to their functional performance but is not intended to represent performance under actual field operating conditions. Test conditions are steady-state, and the dynamic characteristics of industrial hydraulic systems are not represented. Other test protocols exist or are under development to evaluate performance with cyclic flow, high viscosity, flow fatigue, etc.

ISO 23369 (multi-pass testing method for evaluating the performance of hydraulic fluid power filter elements under cyclic-flow conditions) has been developed to supplement the steady-state testing of ISO 16889.

Hydraulic fluid power — Filters — Multi-pass method for evaluating filtration performance of a filter element

1 Scope

This document describes the following:

— a multi-pass filtration performance test with continuous contaminant injection for hydraulic fluid power filter elements;

NOTE 1 For the background interlaboratory study used to verify the test methodology, see Annex D.

— a procedure for determining the contaminant capacity, particulate removal and differential pressure characteristics;

— a test currently applicable to hydraulic fluid power filter elements that exhibit an average filtration ratio greater than or equal to 75 for particle sizes ≥ 25 µm(c), and a final reservoir gravimetric level of less than 200 mg/L;

NOTE 2 It is necessary to determine by validation the range of flow rates and the lower particle size limit that can be used in test facilities.

— a test using ISO medium test dust (ISO MTD) contaminant and a test fluid in accordance with Annex A.

This document is intended to provide a test procedure that yields reproducible test data for appraising the filtration performance of a hydraulic fluid power filter element without influence of electrostatic charge.

This document applies to three test conditions:

— test condition 1, with a base upstream gravimetric level of 3 mg/L;

— test condition 2, with a base upstream gravimetric level of 10 mg/L;

— test condition 3, with a base upstream gravimetric level of 15 mg/L.

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 1219-1, *Fluid power systems and components — Graphical symbols and circuit diagrams — Part 1: Graphical symbols for conventional use and data-processing applications*

ISO 2942, *Hydraulic fluid power — Filter elements — Verification of fabrication integrity and determination of the first bubble point*

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

ISO 3968, *Hydraulic fluid power — Filters — Evaluation of differential pressure versus flow*

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

ISO 4405, *Hydraulic fluid power — Fluid contamination — Determination of particulate contamination by the gravimetric method*

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

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

ISO 11943:2021, *Hydraulic fluid power — Online automatic particle-counting systems for liquids — Methods of calibration and validation*

ISO 12103-1:2016, *Road vehicles — Test contaminants for filter evaluation — Part 1: Arizona test dust*

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 General terms

3.1.1
contaminant mass injected
mass of specific particulate contaminant injected into the test circuit to obtain the terminal differential pressure

3.1.2
rest conductivity
electrical conductivity at the initial instant of current measurement after a d.c. voltage is impressed between electrodes

Note 1 to entry: It is the reciprocal of the resistance of uncharged fluid in the absence of ionic depletion or polarization.

3.1.3
retained capacity
mass of the specific particulate contaminant effectively retained by the filter element when the terminal element differential pressure is reached

3.2 Terms related to differential pressure

3.2.1
differential pressure
difference between the tested component inlet and outlet pressure as measured under the specified conditions

Note 1 to entry: See Figure 1 for a graphical depiction of differential pressure terms.

3.2.2
clean assembly differential pressure
difference between the tested component inlet and outlet pressures as measured with a clean filter housing containing a clean filter element

3.2.3
clean element differential pressure
differential pressure of the clean element calculated as the difference between the clean assembly differential pressure and the housing differential pressure