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Hydraulic fluid power — Monitoring the level of particulate contamination in the fluid —

Part 4: Use of the light extinction technique

Transmissions hydrauliques — Surveillance du niveau de pollution particulaire des fluides —
Partie 4: Technique d'absorption de lumière

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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 on 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 the following URL: www.iso.org/iso/foreword.html.

The committee responsible for this document is ISO/TC 131, *Fluid power systems*, Subcommittee SC 6, *Contamination control*.

ISO 21018 consists of the following parts, under the general title *Hydraulic fluid power — Monitoring the level of particulate contamination of the fluid*:

— *Part 1: General principles*

— *Part 3: Use of the filter blockage technique*

— *Part 4: Use of the light extinction technique*

Introduction

In hydraulic fluid power systems, power is transmitted through a liquid under pressure within a closed 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 liquid to lubricate and causes wear. The extent of contamination in the liquid has a direct bearing on the performance and reliability of the system and should be controlled to an appropriate level.

Quantitative determination of particulate contamination requires precision both in obtaining a representative sample of the liquid and the measurement of the contamination. The awareness of the benefits of cleanliness monitoring has led to the development of instruments that operate online (i.e. directly connected to a system) in an attempt to reduce measurement errors that are inherent with bottle samples. Automatic particle counters (APC) and monitors have been developed and are extensively used.

Instruments using this technique have become widely used in the industry and an International Standard is required in order to standardize operating procedures. This part of ISO 21018 defines procedures for the use of light extinction instruments in evaluating the cleanliness level of a hydraulic liquid. It also includes procedures for calibrating and verifying that the instruments are operating correctly to ensure consistent results.

Hydraulic fluid power — Monitoring the level of particulate contamination in the fluid —

Part 4: Use of the light extinction technique

1 Scope

This part of ISO 21018 specifies a method for the determination of the particulate contamination level using the light extinction technique (also known as light blockage or light obscuration) either online or off-line in containers. It also defines procedures for calibrating the instruments and verifying their correct operation both in the laboratory and in service.

In general, the techniques described in this part of ISO 21018 are suitable for monitoring

— the general cleanliness level in hydraulic systems,

— the progress in flushing operations, and

— support equipment and test rigs.

The use of this method is applicable to single-phase liquid systems only.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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 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 11171:2010, *Hydraulic fluid power — Calibration of automatic particle counters for liquids*

ISO 16889, *Hydraulic fluid power — Filters — Multi-pass method for evaluating filtration performance of a filter element*

ISO 11943[1)], *Hydraulic fluid power — On-line automatic particle-counting systems for liquids — Methods of calibration and validation*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 5598 and the following apply.

1) To be published.

3.1
light extinction
reduction in intensity of a light beam passing through the sensing volume caused by the interaction of the light with single particles

[SOURCE: ISO 11500:2008, 3.3]

3.2
extraneous contamination
contamination that is not an integral part of the fluid from which a sample was taken, but was introduced into the sample from another source

Note 1 to entry: Extraneous contamination increases the measured level of contamination such that the sample appears to be more contaminated than it really is.

4 Health and safety

Operate the instrument in accordance with the manufacturer's instructions. Follow local health and safety procedures at all times.

WARNING — The use of this International Standard can involve hazardous materials, operations and equipment. This International Standard does not purport to address all of the safety concerns 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 regulatory limitations prior to use.

5 Equipment

5.1 General

If the analysis is performed using sample bottles or containers (see 6.5), sampling apparatus (see 5.2.1) could be required. Such apparatus shall avoid introducing contamination when the inlet hose is inserted. For the process of calibration and verification of correct operation, use the equipment detailed in 5.2.

5.2 Equipment for online and off-line calibration and verification

5.2.1 Bottle sampling apparatus, for transferring the calibration or verification sample to the instrument. If a pressure chamber is used to force the liquid through the device at constant pressure, a suitable source of filtered, dried and regulated air is required.

5.2.2 Calibration and verification dust, test dust, designated RM8631, used for calibration or verification or both, shall have a size distribution measured using an automatic particle counter (APC) calibrated in accordance with ISO 11171 or ISO 11943. RM8631 is available from NIST and consists of 20 g of dry dust taken from the same lot as the dust in SRM 2806 and is provided with reference values from 1 micron to 50 microns.

5.2.3 Flushing fluid, separate fluid compatible with the verification fluid for flushing the instrument prior to verification. The fluid shall be pre-cleaned to fewer than 15 particles sized >4 µm(c)/mL or no more than 0,5 % of the expected population of the smallest measured particle size.

NOTE The unit µm(c) refers to particle sizes determined using an APC calibrated in accordance with ISO 11171 or ISO 11943.

5.2.4 Oven, non-circulating, capable of providing a temperature, controlled to ± 5 °C, between 100 °C and 150 °C for drying the test dust. For drying the calibration and verification dust (refer to 5.2.2).

5.2.5 Reference particle counter, an APC calibrated in accordance with ISO 11171 or ISO 11943.

5.2.6 Sample agitating device, suitable for re-dispersing the contaminant within the contents of the sample bottle, such as an ultrasonic bath rated at 3 000 W/m^2 to 10 000 W/m^2 of base area, or a three-axis shaker. The agitating device shall not alter the basic size distribution of the test dust or the contaminants in samples being analysed.

5.2.7 Sample bottles, cleaned and validated in accordance with ISO 3722. Use the following Required Cleanliness Levels (RCLs):

a) for sample bottles used for mixing the test dust: <100 particles ≥ 4 µm(c)/mL of sample bottle volume

b) for sample bottles used for verifying system cleanliness or for preparing the calibration verification samples: <5 particles ≥ 4 µm(c)/mL of sample bottle volume

5.2.8 Solvent, compatible with the instrument and equipment used and miscible with the test liquid. Any solvent used shall be filtered to 0,8 µm or better to achieve an RCL of <2 particles ≥ 4 µm(c)/mL.

5.2.9 Solvent dispenser, pressurized, fitted with a 0,8 µm inline membrane filter at the outlet.

5.2.10 Test rig, validated in accordance with ISO 11943.

5.2.11 Test liquid, conforming to the requirements used for online calibration or validation and conforming to the requirements stated within ISO 16889.

5.2.12 Vacuum source, to de-aerate the test liquid samples after shaking, and may be incorporated in the bottle sampling apparatus. An ultrasonic bath can be used as an alternative method (see 5.2.6).

NOTE 1 De-aeration might not be required if the instrument utilizes a constant pressure source.

NOTE 2 The effectiveness of ultrasonics in removing air is reduced as the viscosity of the test liquid increases.

5.2.13 Verification samples, sample bottles containing a suspension of RM8631 in oil that is compatible with the instrument concerned and at a concentration specified by the instrument manufacturer. The particle size distribution shall be determined using a reference particle counter (see 5.2.5).

5.2.14 Weighing balance, with a resolution of 0,05 mg or better.

6 Operating procedures

6.1 General

Select the mode of operation from the following:

— from a pressurized line (see 6.2);

— by suction from a system reservoir (see 6.3);

— by suction from a bulk container (see 6.4);

— from a sample bottle (see 6.5).

Operating online from a pressurized source is preferred as it eliminates contamination from the environment. Select the sampling position and sampling valves in accordance with ISO 4021. If periodic or continuous trend monitoring is being carried out on a machine or process, take repeat samples from the same place, in the same manner and under similar operating conditions.