INTERNATIONAL STANDARD

ISO 21018-4

Second edition
2019-08

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

Reference number
ISO 21018-4:2019(E)

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

Page

Foreword ..... **iv**
Introduction ..... **v**
1 Scope **1**
2 Normative references **1**
3 Terms and definitions **1**
4 Health and safety **2**
5 Equipment **2**
5.1 General 2
6 Operating procedures **2**
6.1 General 2
6.2 Operating from a pressurized line 3
6.2.1 General 3
6.2.2 Procedure 3
6.3 Operating from a system reservoir 4
6.3.1 General 4
6.3.2 Procedure 4
6.4 Operating from a bulk container 5
6.4.1 General 5
6.4.2 Procedure 5
6.5 Operating from a sample bottle 6
6.5.1 General 6
6.5.2 Procedure 6
7 Calibration and verification procedure **6**
7.1 General principles 6
7.2 Required equipment for calibration and validation as per ISO 11943 7
7.3 Required equipment for calibration and validation using prepared bottle samples 7
8 Reporting of results of calibration and verification procedure **7**
9 Test reports **8**
10 Identification statement **9**
Bibliography **10**

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 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 the following URL: 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 21018-4:2016), which has been technically revised. The main changes compared to the previous edition are as follows:

— simplification of calibration procedure in Clause 7;

— moving the equipment for the calibration and validation procedure from Clause 5 to Clause 7 after the Operating Procedures.

A list of all parts in the ISO 21018 series can be found on the ISO website.

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, 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. Particle contamination monitors (PCM) have been developed for this purpose 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 document 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 document 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 offline 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 document 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 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 11171:2016, *Hydraulic fluid power — Calibration of automatic particle counters for liquids*

ISO 11500:2008, *Hydraulic fluid power — Determination of the particulate contamination level of a liquid sample by automatic particle counting using the light-extinction principles*

ISO 11943:2018, *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.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at http://www.iso.org/obp

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

Note 1 to entry: See 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.

Note 2 to entry: See ISO 21018-4:2016, 3.2.

3.3
particle contamination monitor
PCM
instrument that automatically measures the concentrations of particles suspended in a fluid at certain sizes and cannot be calibrated in accordance with ISO 11171 whose output may be as a particle size distribution at limited sizes or as a contamination code

3.4
µm(c)
particle size as defined in accordance with ISO 11171

4 Health and safety

Operate the instrument in accordance with the manufacturer's instructions.

WARNING — The use of this document can involve hazardous materials, operations and equipment. This document does not purport to address all of the safety concerns associated with its use. It is the responsibility of the user of this document 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), a special sampling adaptor (sampler) may be required (see 6.2.1). Such an apparatus shall avoid introducing contamination if the inlet pipe is inserted into the sample bottle. For the process of calibration and verification of correct operation, see Clause 7.

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.

6.2 Operating from a pressurized line

6.2.1 General

WARNING — Ensure that all equipment and procedures used are safe and compatible with the maximum system pressure.

Select the sampling valve or apparatus so that it complies with ISO 4021. Position the sampling valve in a flow line that carries a significant flow and at a point of turbulence, such as after an elbow. Any pressure connection used as a sampling valve shall comply with the requirements of ISO 4021. Such a tapping point can require sustained flushing.

6.2.2 Procedure

6.2.2.1 Ensure that the system is at its normal operating conditions. Ensure that the instrument operates properly at both the minimum and maximum pressure observed when connected to the hydraulic system.

6.2.2.2 Establish whether there is any liquid residual from a previous analysis in the instrument and whether the residual liquid is miscible with the current test liquid. If there is any doubt, flush the previous fluid out of the unit in accordance with the instrument manufacturer's recommendations.

6.2.2.3 Clean the outside of the sampling valve with a suitable pre-cleaned solvent and a lint-free cloth then connect the instrument to the sampling valve.

6.2.2.4 Operate the instrument in accordance with the manufacturer's instructions. If the instrument does not have an automatic self-flushing sequence, run the instrument to ensure that the sampling line and instrument are adequately flushed. If the instrument was previously used to analyse a different but miscible liquid, flush with at least 10 complete volumes (instrument and connecting pipes) of system liquid and direct to waste.

6.2.2.5 Initiate the PCM analysis in accordance with the manufacturer's instructions. Perform at least two analyses and compare the results. Verify that the procedure was followed correctly and repeat the analysis if either:

a) the difference between two successive cleanliness codes for instruments whose output is in cleanliness codes is greater than 1 code, or

b) the difference in particle counts is greater than 20 % under steady state conditions at the smallest particle size being monitored.

6.2.2.6 After analysis, close the sample valve and ensure that any residual pressure has been exhausted from the sampling line before disconnecting the instrument.

6.2.2.7 Record the data in accordance with Clause 9.

