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Hydraulic fluid power — Calibration of automatic particle counters for liquids

Transmissions hydrauliques — Étalonnage des compteurs automatiques de particules en suspension dans les liquides

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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.

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

This fourth edition cancels and replaces the third edition (ISO 11171:2016), which has been technically revised.

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The main changes compared to the previous edition are as follows:

— Clause 1 and 4.4: SRM 2806b are not used for sizing calibration purposes with this document;

— 3.1: the definition of an automatic particle counter (APC) is clarified;

— 3.8 (Note 1 to entry): the particle size distribution for primary calibration suspension samples is found in Table 3 of the SRM 2806x Certificate of Analysis;

— 4.6: ISO medium test dust (MTD) or other test dust conforming to ISO 12103-1 for secondary calibration suspension is permitted;

— 4.8: APC are required to have a minimum of 8 channels that can be set instead of only 6;

— 6.1: latex spheres are required for primary calibration at particle sizes greater than 30 µm(c);

— 6.1: secondary calibration suspensions can be used for secondary calibration at particle sizes greater than 30 µm(c);

— 6.2: both reference and certified data from the SRM 2806x particle size distribution are used for primary sizing calibration;

— 6.2: data from at least 16 different particle sizes taken from the certified particle size distribution are used to create the APC calibration curve;

— 6.3: data obtained from at least 12 different APC threshold voltage settings are used to relate particle concentrations to threshold settings;

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— 6.6: the data acceptance criteria are based upon the mean number of particles counted rather than particle concentration;

— 6.6: dilution of calibration suspensions is permitted to allow the calibration of APCs at sizes that would otherwise be in coincidence error for calibration suspensions;

— 6.9: the constrained cubic spline method of interpolation is specified and a tool for its use to relate threshold voltage setting to particle size is provided;

— 6.9: the standard uncertainty in particle concentration at each threshold setting is calculated and reported;

— 6.11 – 6.14: the modified differential half-count method for relating particle size and threshold setting using latex spheres is specified for primary calibration of particle sizes greater than 30 µm(c);

— 6.15: the constrained cubic spline method of interpolation is specified for relating threshold voltage setting to particle size and a tool for its use to relate threshold voltage setting to particle size and to construct an APC calibration curve is provided;

— Clause 7: the only acceptable way of reporting particle size using this document is using the unit of µm(c);

— Table A.1: the median, upper and lower acceptable particle concentration limits have been updated based on the results of interlaboratory testing using RM 8632a test dust and calculated based upon the logarithm of the observed particle counts and 98 % confidence level;

— Table C.2: acceptable values for D_Q are based upon the mean number of particles counted rather than particle concentration;

— F.2: use of NIST RM 8631x, ISO MTD, or other test dust conforming to ISO 12103-1 for secondary calibration suspensions is permitted and the maximum allowable concentration for secondary suspensions is increased from 75 % to 100 times the coincidence error limit of the sensor;

— F.4 and F.7: data are obtained from at least 16 different particle sizes and reported in the certificate of analysis for the resultant secondary calibration suspensions;

— Annex G: this new annex specifies the method of dilution for calibration suspension samples for use in 6.6 for samples that would otherwise be in coincidence error;

— Annex H, Sample calculations, from ISO 11171:2016: deleted. Replaced by Annex H, Verification of particle size distribution of calibration samples.

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 fluid is both a lubricant and a power-transmitting medium. Reliable system performance requires control of the contaminants in the fluid. Qualitative and quantitative determination of the particulate contaminants in the fluid medium requires precision in obtaining the sample and in determining the contaminant particle size distribution and concentration. Liquid automatic particle counters (APC) are an accepted means of determining the concentration and size distribution of the contaminant particles. Individual APC accuracy is established through calibration.

This document is a standard calibration procedure for APC that are used for determining particle sizes and counts. The primary particle-sizing calibration is conducted using NIST SRM 2806x suspensions with particle size distribution certified by the United States National Institute of Standards and Technology (NIST) for particle sizes 30 µm(c) and smaller, and using polystyrene latex spheres at larger sizes.

A secondary calibration method uses suspensions of NIST RM 8631x, ISO MTD, or other test dust conforming to ISO 12103-1, which are independently analysed using an APC calibrated by the primary method. Minimum performance specifications are established for the APC coefficient of variation (CV) of sample volume, CV of flow rate, resolution and particle counting accuracy. The operating limits of an APC, including its threshold noise level, coincidence error limit and flow rate limits are determined.

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Hydraulic fluid power — Calibration of automatic particle counters for liquids

1 Scope

This document specifies procedures for the following:

a) primary particle-sizing calibration for particle sizes 1 µm(c) and larger, sensor resolution and counting performance of liquid automatic particle counters that are capable of analysing bottle samples;

b) secondary particle-sizing calibration using suspensions verified with a primary calibrated APC;

c) establishing acceptable operation and performance limits;

d) verifying particle sensor performance using a test dust;

e) determining coincidence and flow rate limits.

This document is applicable for use with hydraulic fluids, aviation and diesel fuels, engine oil and other petroleum-based fluids. This document is not applicable to particle-sizing calibration using NIST SRM 2806b primary calibration suspensions.

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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 11171:2020

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

ISO 4787, *Laboratory glassware — Volumetric instruments — Methods for testing of capacity and for use*

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

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

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

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:

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

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

3.1
automatic particle counter
APC
instrument that automatically:

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