
**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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 11171 was prepared by Technical Committee ISO/TC 131, *Fluid power systems*, Subcommittee SC 6, *Contamination control*.

This second edition of ISO 11171 cancels and replaces the first edition (ISO 11171:1999), of which it constitutes a technical revision, including the following modifications to clarify the steps to be performed when using this International Standard and to minimize several potential sources of variability. Specifically:

- a) A definition of an automatic particle counter (APC) has been added as 3.1.
- b) In 5.1, the specific sequence of steps to be followed in calibration is no longer mandated.
- c) In 5.1, Note 2 has been added to provide guidance on how to detect a change in the calibration of an APC.
- d) 6.3 now explicitly requires that at least 5 000 particles be counted in order to have statistically valid data for a particular channel setting.
- e) B.4 no longer requires that a 0 % sample be prepared and analysed; instead, the regression equation for coincidence error determined in B.7 is forced through the origin.
- f) Annex C now distinguishes between fixed flow rate and adjustable flow rate bottle samplers. Fixed flow rate instruments simply require verification of their ability to consistently deliver a constant flow rate within 3 %. For adjustable flow rate instruments, this International Standard requires that their working flow rate and flow rate limits be determined, in addition to verification of their ability to consistently deliver a constant flow rate within 3 %.
- g) D.12 increases the acceptable resolution of an APC from 10 % to 15 %.
- h) E.3 requires that NIST RM 8632 must be used for verification of counting accuracy. Use of ISO UFTD is no longer acceptable.
- i) Annex H now includes an example of how to construct a calibration curve.

It also incorporates the Technical Corrigendum ISO 11171:1999/Cor.1:2001.

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 (APCs) are an accepted means of determining the concentration and size distribution of the contaminant particles. Individual APC accuracy is established through calibration.

This International Standard establishes a recommended standard calibration procedure for determining particle sizing and counting accuracy. The primary particle-sizing calibration is conducted using NIST SRM 2806 suspensions with particle size distribution certified by the United States' National Institute of Standards and Technology (NIST). A secondary calibration method with traceability to NIST uses suspensions of ISO MTD which are independently analysed using an APC calibrated by the primary method. Concentration limits are determined through the use of serial dilutions of a concentrated suspension. Operation and performance limits are also established using this International Standard.

Hydraulic fluid power — Calibration of automatic particle counters for liquids

1 Scope

This International Standard specifies procedures for:

- a) primary particle-sizing calibration, sensor resolution and counting performance of automatic particle counters (APCs) for liquids 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 truncated test dust;
- e) determining coincidence and flow rate limits.

2 Normative references

The following referenced documents are indispensable for the application 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 5598, *Fluid power systems and components — Vocabulary*

ISO 12103-1, *Road vehicles — Test dust 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*

ISO 21501-3, *Determination of particle size distribution — Single particle light interaction methods — Part 3: Light extinction liquid-borne particle counter*

3 Terms and definitions

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

3.1

automatic particle counter

APC

instrument that automatically counts and sizes individual particles suspended in a fluid, typically relying on optical light scattering or light extinction principles of particle sizing