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Hydraulic fluid power — Fluids — Method for coding the level of contamination by solid particles

Transmissions hydrauliques — Fluides — Méthode de codification du niveau de pollution particulaire solide

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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 fourth edition cancels and replaces the third edition (ISO 4406:2017), which has been technically revised.

The main change compared to the previous edition is as follows:

— the use of Particle Contamination Monitors (PCMs) can also be utilized for the determination of the ISO 4406 contamination code (see subclause 4.4.1) and PCM is referenced throughout this document.

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 and controlled through a liquid under pressure within an enclosed circuit. Solid particle contaminant is always present in the hydraulic fluid and the amount needs to be determined because the contaminant may cause serious problems.

The ISO 4406 cleanliness code has gained world-wide acceptance as a means of communicating the cleanliness of a hydraulic fluid. Most hydraulic component manufacturers require a certain ISO cleanliness level for warranty purposes, to ensure proper function and for a long, trouble-free life.

Hydraulic fluid power — Fluids — Method for coding the level of contamination by solid particles

1 Scope

This document specifies the code to be used in defining the quantity of solid particles in the fluid used in a given hydraulic fluid power system.

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 4407, *Hydraulic fluid power — Fluid contamination — Determination of particulate contamination by the counting method using an optical microscope*

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

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

ISO 21018-3, *Hydraulic fluid power — Monitoring the level of particulate contamination of the fluid — Part 3: Use of the filter blockage technique*

ISO 21018-4, *Hydraulic fluid power — Monitoring the level of particulate contamination in the fluid — Part 4: Use of the light extinction technique*

3 Terms and definitions

No terms and definitions are listed in this document.

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/

4 Code definitions

4.1 General

The purpose of this code is to simplify the reporting of particle count data by converting the numbers of particles into broad classes or codes, where an increase in one code generally represents a doubling of the contamination level.

The original code, in accordance with the first edition of this document, stated the reporting at two sizes: ≥ 5 µm and ≥ 15 µm. The sizes in this document account for the use of a different calibration standard for optical automatic particle counters (APCs). The reported sizes are ≥ 4 µm(c), ≥ 6 µm(c) and

≥ 14 µm(c), as per ISO 11171. The last two of these are equivalent to the 5 µm and 15 µm particle sizes specified in the first edition.

NOTE Throughout this document, the use of µm(c) means that particle size measurements are carried out using an APC that has been calibrated in accordance with ISO 11171 or a particle contamination monitor (PCM) calibrated to ISO 21018-3 or ISO 21018-4.

Measurement of particles using an optical microscope as specified within ISO 4407 establishes the size of a particle as being equal to its longest dimension, whereas an APC derives the size of an equivalent particle from its cross-sectional area, a value different in most cases from that determined using a microscope.

The particle sizes to be reported for measurement by microscope ≥ 5 µm and ≥ 15 µm are unchanged from those specified in the first edition of this document.

CAUTION — Particle counts are affected by a variety of factors. These factors include procurement of sample, particle counting accuracy and the sample container (where used), and its cleanliness. Proper care should be taken during sample procurement to ensure that the sample obtained is representative of the fluid circulation within the system.

4.2 Basis of code

The code for contamination levels using APCs or PCMs comprises three scale numbers that permit the differentiation of the dimension and the distribution of the particles as follows:

— the first scale number represents the number of particles equal to or larger than 4 µm(c) per millilitre of fluid;

— the second scale number represents the number of particles equal to or larger than 6 µm(c) per millilitre of fluid; and

— the third scale number represents the number of particles equal to or larger than 14 µm(c) per millilitre of fluid.

The code for microscope counting comprises two scale numbers using 5 µm and 15 µm.

4.3 Allocation of scale numbers

4.3.1 The scale numbers are allocated according to the number of particles counted per millilitre of the fluid sample (see Table 1).

4.3.2 A step ratio of generally two, as given between the upper and lower limits for the number of particles per millilitre in Table 1, has been adopted to keep the number of scale numbers within a reasonable limit and to ensure that each step is meaningful.

Table 1 — Allocation of scale numbers

Number of particles per millilitre		Scale number[a]
More than	Up to and including	
2 500 000	—	> 28
1 300 000	2 500 000	28
640 000	1 300 000	27
320 000	640 000	26
160 000	320 000	25
80 000	160 000	24

[a] Reproducibility below scale number 8 is affected by the actual number of particles counted in the fluid sample. Raw count should be more than 20 particles. If this is not possible, refer to 4.4.7.

Table 1 *(continued)*

Number of particles per millilitre		Scale number[a]
More than	**Up to and including**	
40 000	80 000	23
20 000	40 000	22
10 000	20 000	21
5 000	10 000	20
2 500	5 000	19
1 300	2 500	18
640	1 300	17
320	640	16
160	320	15
80	160	14
40	80	13
20	40	12
10	20	11
5	10	10
2,5	5	9
1,3	2,5	8
0,64	1,3	7
0,32	0,64	6
0,16	0,32	5
0,08	0,16	4
0,04	0,08	3
0,02	0,04	2
0,01	0,02	1
0,00	0,01	0

[a] Reproducibility below scale number 8 is affected by the actual number of particles counted in the fluid sample. Raw count should be more than 20 particles. If this is not possible, refer to 4.4.7.

4.4 Determination of code using automatic particle counter analysis

4.4.1 Counting shall be undertaken in accordance with ISO 11500 or another recognized method, using an APC calibrated to ISO 11171 or a PCM calibrated to ISO 21018-3 or ISO 21018-4.

4.4.2 A first scale number shall be allocated to the number of particles equal to or larger than 4 µm(c).

4.4.3 A second scale number shall be allocated to the number of particles equal to or larger than 6 µm(c).

4.4.4 A third scale number shall be allocated to the number of particles equal to or larger than 14 µm(c).

4.4.5 The three numbers shall be written one after the other and separated by oblique strokes (slashes).

EXAMPLE A code of 22/18/13 signifies that there are more than 20 000 and up to and including 40 000 particles equal to or larger than 4 µm(c), more than 1 300 and up to and including 2 500 particles equal to or larger than 6 µm(c), and more than 40 and up to and including 80 particles equal to or larger than 14 µm(c) in 1 mL of a given fluid sample.

