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Aerospace — Cleanliness classification for aeronautical fluids

Aéronautique et espace — Classes de propreté des fluides aéronautiques

[Revision of first edition (ISO 11218:1993)]

ICS 49.080

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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 11218 was prepared by Technical Committee ISO/TC 20, *Aircraft and Space Vehicles*, Subcommittee SC 10, *Aerospace fluid systems and components*.

This second edition cancels and replaces the first edition (ISO 11218:1993), which has been technically revised. It significantly differs from the previous issue by the adoption of cumulative particle counting and particle sizes in μm(c).

Introduction

The presence of particulate contamination in the fluid of aeronautical hydraulic systems has a deleterious effect on both the components and the fluid making up hydraulic systems. To enhance performance, reliability and safety, contamination has to be maintained at low levels. The appropriate level for a specific system will depend upon the requirements of both the system and the operator, and will be specified.

There are many types of contamination (air, water, microorganismes, solid particles, chemicals, etc.). This standard is concerned with contamination by solid particles. The level of contamination of aircraft hydraulic fluids by solid particles shall be checked and maintained within a given definition range. The definition range is characterised by the size and the number of particles. Determination of the size and numbers of particulate contamination requires precision in obtaining the sample and in the analysis. If not errors will result and erroneous conclusions will be drawn

Knowledge of contamination is essential to determine its origin and then to prevent it.

To simplify the reporting and analysis of data, ISO 11218 was developed to represent the particle count data by a series of broadly based bands of contamination. The original version of ISO 11218 has been updated to include technical improvements in measuring particles and also meet current and future requirements.

Aerospace — Cleanliness classification for aeronautical fluids

1 Scope

This International Standard defines how to express the cleanliness of aeronautical fluids. The fluid cleanliness is defined by comparing the measured contamination level to a specified cleanliness threshold.

An aeronautical fluid is stated being clean when its measured contamination level is less than the cleanliness / contamination level specified.

It details maximum allowable particle populations at defined sizes.

It uses the contamination classes specified in the previous 1993 version of this ISO and in the NAS 1638 (superseded by AS4059) and NF L 41-101 standards.

The contamination classes expressed in compliance with the current standard cannot be compared to those expressed in compliance with the ISO 4406 standard applicable to industrial hydraulic fluids.

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 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 11217, *Aerospace — Hydraulic system fluid contamination — Location of sampling points and criteria for sampling.*

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 TR 16386, *Impact of changes in ISO fluid power particle counting, contamination control and filter test standards.*

3 Definitions

In this standard, the definitions given in ISO 4407 and ISO 11500 and the following definitions apply.

3.1 particle size

the longest dimension of the particle in case of microscopic counting or the diameter of the equivalent sphere in case of automatic light extinction particle counting (see Figure 1)

3.2 particle size range

particle sizes included in a specified interval

3.3 automatic particle counter (APC)

instrument based on the light extinction principle able to size and record the passage of single particles in the sample fluid and calibrated in accordance with ISO 11171. The measured particle size is equal to the diameter of the sphere with the same projected area as the analysed particle.

3.4 cleanliness

condition of a fluid characterized by a level of particulate contamination lower than the specified level.
NOTE this term is preferred when one deals with a specification

3.5 particulate contamination

all undesirable particles which are in a fluid
NOTE this term is preferred when one deals with measurements

4 Principle

The cleanliness level of aerospace fluids is expressed by their particulate contamination levels. The particulate contamination levels of fluids are measured by counting the number of particles in different standard size ranges and referred to a volume of 100 mL of the fluid analysed. This contamination level is expressed by a contamination code and/or a contamination class determined by comparing the numbers measured to the acceptable numbers specified in Tables 1 and 2.

5 Sampling

Sampling shall be performed in accordance with ISO11217.

6 Particulate contamination analysis methods

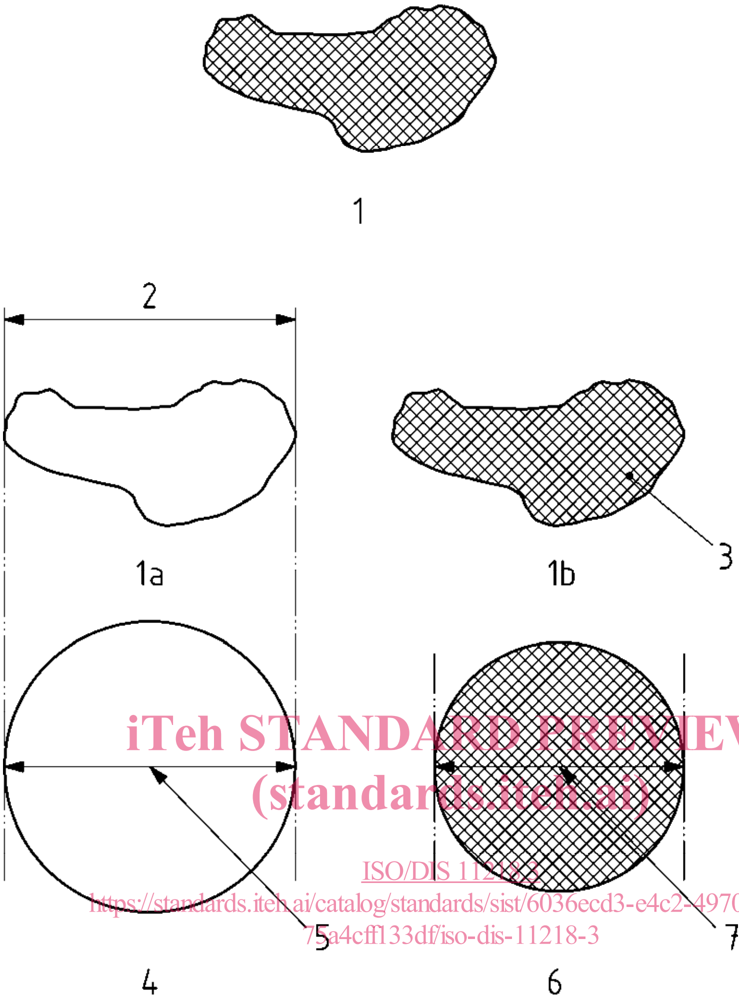
6.1 Particle size analysis

Several methods and instruments based on different physical principles can be used to determine the size distribution of the particles suspended in aeronautical fluids. The numbers of particles found in the different size ranges characterize this distribution. A single particle may be sized differently depending on both the size analysis technique and the method of calibration.

Figure 1 shows the particle being sized:

— If the technique is the optical microscope then it will be sized by its longest dimension (1a) giving 13 µm (5). See Figure 1a.

— If it is analysed using an APC calibrated in accordance with ISO 11171, it will be sized according to its projected area (1b) equivalent diameter giving 10µm (7). See Figure 1b.



Key

1 Particle to be analyzed

1a Sized by microscope or image analysis based on "longest dimension"

1b Sized by APC calibrated as per ISO 11171 set up to give the "diameter of a sphere with the same equivalent projected area"

2 Particle longest dimension (d = 13µm)

3 Particle projected area (A = 78.5 µm^2)

4 Sphere with same longest dimension as actual particle

5 Diameter of sphere with same longest dimension (d = 13 µm)

6 Spherical particle with same projected area as actual particle (A = 78.5 µm^2)

7 Diameter of sphere with same projected area as actual particle (d = 10µm(c))

Figure 1 — Effect of the analysis technique on the reported size of a particle

6.2 Counting by microscopy

The operating procedure is described in ISO 4407, which covers the manual and image analysis assisted microscopic counting methods. By convention, the size of particles is their longest dimension.

In case of dispute on analysis results using all other counting methods, the microscopic counting method will be the reference method.

6.3 Counting by light extinction automatic particle counters

The operating procedure is described in ISO 11500. By convention, the size of the particle is the diameter of the sphere with the same projected area. APCs are calibrated and validated in compliance with the ISO 11171.

NOTE There are still companies using particle counters which may be calibrated in compliance with the ISO 4402 procedure (cancelled in 1999) based on non certified ACFTD powder. In case of dispute the customer may require a particle counting with a device calibrated per ISO 11171. See ISO TR16386 for additional information. It is recommended to have a correlation by cross check between APCs calibrated with ACFTD powder versus APC calibrated with Standard Reference Material (SRM) 2806 prepared by the National Institute of Science and Technology (NIST) in the USA, as illustrated in Annex A.

APCs are used either in clean atmospheres or in laboratory conditions with bottle samplers or fitted on-line on appropriate fluid circuits equipped with sampling valves in accordance with ISO 11217.