BS ISO 14085-6:2015

BSI Standards Publication

Aerospace series — Hydraulic filter elements — Test methods

Part 6: Initial cleanliness level

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National foreword

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A list of organizations represented on this committee can be obtained on request to its secretary.

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Part 6: Initial cleanliness level

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Foreword

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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).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 20, *Aircraft and space vehicles*, Subcommittee SC 10, *Aerospace fluid systems and components*.

ISO 14085 consists of the following parts, under the general title *Aerospace series — Hydraulic Filter elements — Test methods*:

— *Part 1: Test sequence*

— *Part 2: Conditioning*

— *Part 3: Filtration efficiency and retention capacity*

— *Part 4: Verification of collapse/burst pressure rating*

— *Part 5: Resistance to flow fatigue*

— *Part 6: Initial cleanliness level*

Introduction

In aerospace hydraulic fluid power systems, power is transmitted and controlled through a liquid under pressure. The liquid is both a lubricant and power-transmitting medium. The presence of solid contaminant particles in the liquid interferes with the ability of the hydraulic fluid to lubricate and causes wear and malfunction of the components. The extent of contamination in the fluid has a direct bearing in the performance, reliability, and safety of the system, and needs to be controlled to levels that are considered appropriate for the system concerned.

Filters are used to control the contamination level of the fluid by removing solid contaminant particles, typically consisting of a filter element enclosed in a filter housing. The filter element is the porous device that performs the actual process of filtration. The complete assembly is designated as a filter.

Hydraulic fluid circuits require high levels of cleanliness which are not to be degraded by the filter element itself when installed into the circuit. This procedure defined a test method to determine the initial cleanliness level of a new hydraulic filter element.

INTERNATIONAL STANDARD ISO 14085-6:2015(E)

Aerospace series — Hydraulic filter elements — Test methods —

Part 6: Initial cleanliness level

1 Scope

This part of ISO 14085 defines a reference method for determining the level of cleanliness of new filter elements for use in aircraft hydraulic systems, after production prior to shipment, or prior to installation in the circuit.

It applies to filter elements used on systems requiring fluid cleanliness conditions defined in the particular specification.

The tests data resulting from application of this part of ISO 14085 can be used to compare the cleanliness of aerospace hydraulic filter elements.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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 4405, *Hydraulic fluid power — Fluid contamination — Determination of particulate contamination by the gravimetric method*

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

3 Terms and definitions

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

3.1
extraction liquid
test liquid extracted from the filter housing in which the filter element is installed during agitation

4 Summary of test method

The test consists of inserting the test filter element into a pre-cleaned filter housing and adding a solvent. The filter assembly shall then be agitated to flush and collect built-in contaminant from a new filter element. Multiple extraction liquid samples shall be used to achieve maximum contaminant removal. The collected contaminant shall then be analysed using particle counting or gravimetric techniques, and the amount of contamination shall be reported.

5 Materials and equipment

5.1 Test liquid: Use a suitable solvent with a viscosity less than 5 mm^2/s at test temperature. The test liquid shall be compatible with all materials used in the filter, as well as with the functional liquid of the

system in which the filter will be applied. The test liquid should be compatible with all test apparatus, including seals and filters, and filtered to the agreed initial cleanliness level.

The supplier and purchaser should agree upon the test liquid to be used in the collection process, and its required initial cleanliness level, prior to the test. The contamination contained in the entire test liquid volume to be used shall be less than 1 % of the presumed or allowable contamination level of the filter element or class 1 per ISO 11218, so that it does not significantly influence the measured contamination level. If the expected contamination level is unknown, a maximum contamination level of three particles larger than or equal to 6 µm(c), or equivalent, per millilitre of container volume is considered appropriate.

WARNING — Exercise care when using test liquids with low flash points.

5.2 Test filter housing: Use a test filter housing (recommended by the filter manufacturer). Preferably the housing type to be used in service can be utilized for the cleanliness test. The test housing shall be pre-cleaned to achieve the required blank value. The plugs used to seal the housing shall also be pre-cleaned.

5.3 Collection tray and/or vessels: Clean all collection apparatus to achieve the required blank value. Any collection apparatus should be covered after cleaning and prior to use in order to limit contamination from the environment.

NOTE It is possible for contaminant remaining on the collection apparatus to be transferred to the sample and included as part of the contaminant attributed to the filter element.

5.4 Clean sample containers: Sample containers shall be sufficiently clean so as not to affect the results of contaminant analysis. If the expected contamination level is unknown, a maximum contamination level of three particles larger than or equal to 6 µm(c), or equivalent, per millilitre of container volume is considered appropriate. Qualify and control container cleanliness in accordance with ISO 3722.

5.5 Calibrated graduated cylinder: Use a calibrated graduate cylinder for fluid volume measurement that is sufficiently clean so as not to affect the results of contaminant analysis.

6 Procedure

6.1 Clean the test filter housing as required with clean test liquid by either pressure rinsing, flushing, or agitation.

6.2 After cleaning the housing, conduct a final agitation by filling the housing approximately 2/3 full with clean test liquid. Record the volume of the test fluid added (minimum accuracy ±5 %) on the report sheet of Annex B. Put clean plugs into the inlet and outlet ports, conduct the agitation in accordance with a predetermined method, then pour the test fluid into a clean sample container. See ISO 18413 for guidance.

NOTE Insertion of the port plugs can generate contamination that will be included in the blank sample. Use clean plugs and caution not to over tighten the port plugs.

6.3 Measure the contamination contained in the entire housing sample (blank) per the procedures of Clause 7, and record on the report sheet of Annex B. If the total contamination in the housing blank sample is less than 10 % of the presumed or allowable contamination level of the filter element, then record the value on the report sheet in Annex B and proceed with the test. If the blank levels exceed the requirements, the housing and all of the equipment used shall be cleaned until the level is acceptable.

6.4 Insert the filter element to be tested into the cleaned filter housing.

6.5 Fill the filter assembly approximately 2/3 full of clean test liquid. Record the volume of fluid added (minimum accuracy ±5 %) on the report sheet of Annex B. The volume of fluid added should be measured with a calibrated graduated cylinder that is sufficiently clean so as to not affect the results of contaminant analysis.

6.6 Insert clean plugs into the inlet and outlet ports.

NOTE Insertion of the port plugs can generate contamination that will be included in the sample. Use clean plugs and take care not to over tighten the port plugs.

6.7 Agitate in accordance with a predetermined method, reporting all relevant data (duration, frequency, amplitude, and direction).

6.8 Remove the port plugs and pour the extraction liquid from the outlet port into a clean sample container.

6.9 Measure the contamination level of the entire extraction liquid sample per the procedures of Clause 7, and label the result as *C1*.

6.10 Repeat 6.5 to 6.9 twice and record these repetitions as *C2* and *C3*. Determine whether $C3 \leq 0{,}1 \times (C1+C2+C3)$ and if so, the extraction is complete. If not repeat 6.5 to 6.9 until $Cn < 0{,}1 \times \sum(C1 \ldots Cn)$

6.11 If 6 extractions have been performed without $C6 < 0{,}1 \times \sum(C1 \ldots C6)$, then the extraction parameters are not suitable and shall be modified. Repeat operations 6.4 to 6.9 with new extraction parameters on a new filter element.

6.12 Record the results of the individual tests on the report sheet of Annex B.

7 Contaminant analysis

7.1 Method of analysis

Analyse the liquid samples collected using one of the methods described in Annex A. The method of contaminant analysis shall be agreed upon between all parties involved.

The whole extraction fluid volume should be analysed to quantify the total amount of contaminant. The amount of contaminant shall be expressed per 100 cm^3 of wetted volume of the housing with filter element installed.

7.2 Reporting of results

Report the results of the contamination analyses on the report sheet in Annex B.

8 Criterion for acceptance

Accept the cleanliness of the filter element if the reported cleanliness, as determined by the agreed contamination analysis method, is equal to or better than component cleanliness specified in the inspection document or specification.

9 Identification statement

Use the following statement in test reports, catalogues, and sales literature when electing to comply with this part of ISO 14085.

"Method for determining filtration performance data in accordance with ISO 14085-6, *Aerospace series — Hydraulic Filter elements — Test methods — Part 6: Cleanliness Level.*"

Annex A
(informative)

Contaminant analysis methods

A.1 General principles

The measured cleanliness level of a filter element depends upon the procedures used to analyse the contaminant. Because the sample extracted will often contain small amounts of contaminant diluted significantly in test liquid, good laboratory techniques are necessary to avoid both loss of contaminant and cross-contamination from other sources during analysis. It is a basic principle of component cleanliness assessment that whole extraction liquid volume be analysed. Analysis of a portion of the extraction liquid volume can be acceptable if only small particles (<50 µm) are analysed. Then appropriate mixing and sampling techniques must be applied and agreed upon between parties.

A.2 Overview

A variety of standard laboratory methods can be used to produce the required filter element cleanliness data. The data reporting format and contaminant analysis method are closely related. This part of ISO 14085 describes three basic contaminant analysis methods: gravimetric, particle size, and particle size distribution. Other methods of analysis can also be used when agreed upon between parties.

A.3 Gravimetric analysis

Use gravimetric analysis methods to obtain information about the mass of contaminant on the filter element. Analyse the whole extraction liquid volume to collect all of the contaminants extracted from the housing or filter element. Contaminants are generally separated from the extraction liquid by filtration through a fine membrane filter under controlled conditions as described in ISO 4405. Contaminant concentration (mass per part) is determined by weighing the amount of material deposited on the membrane filter after filtration.

A.4 Particle size

Perform microscopic analysis methods to obtain information about the size of specific contaminant particles or to measure the size of the largest particle found in/on the test filter element. Analyse the whole extraction liquid volume to collect all of the contaminants extracted from the housing or filter element. Contaminant is generally separated from the test liquid by filtration through a fine membrane filter under controlled conditions. Contaminant residue is examined to determine particle size by means of optical microscope or optical image analyser (see ISO 4407), scanning electron microscope, or other image producing instruments. Size parameter (total area or equivalent projected area diameter or longest linear dimension) should be specified when reporting data.

A.5 Particle size distribution

Measure particle size distribution using particle counting methods to obtain information on the size distribution of contaminants. Data on particle size distribution are often used as a final cleanliness check. Analyse the whole extraction liquid volume to collect all of the contaminants extracted from the housing or filter element. The number and size of particles are determined by means of an appropriate counting method, such as an automatic optical particle counter using light extinction sensors (see ISO 11500), a contamination monitor (see ISO 21018), and an optical microscope with or without an image analyser (see ISO 4407).

If an automatic optical particle counter or contamination monitor is to be used, ensure by either visual inspection, sedimentation, or sieving that no particle has a size larger than the passageway "window" of the sensor.

If contaminants are to be sized and counted by microscopy, then care shall be taken to ensure

a) a homogeneous deposition of particles over the entire surface of the membrane, and

b) the surface density of particles, i.e. their number per unit surface area of the membrane filter, is low enough to allow their individual sizing / counting. This can require that a similar extraction liquid volume is filtered onto several membrane filters. Then all results shall be added to generate the final result.

Report the results as number of particles (in each size range counted) on the entire filter element, and record on the report sheet in Annex B.

Annex B
(informative)

Filter element cleanliness test data report form

Test laboratory: ..... Test date: ..... Operator: .....

Filter and element identification

Element identification number: ..... Housing identification number: .....

Solvent used for flushing

Type: ..... Viscosity at test temperature: ..... mm^2/s Temperature ..... °C

Fluid volumes:

Housing volume: ..... l Volume used for blank test: ..... l Volume used for filter element test: l

Volume analysed: l

Gravimetric test results:

	Blank level (empty housing)	**Filter element**
Gravimetric result (mg/component)		

Particle count test results:

	Blank level (empty housing)	**Filter element**
Particle size range	Number of particles per component	
µm		
µm		
µm		
µm		

Comments: .....

.....

.....

Bibliography

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

[2] ISO 11218, *Aerospace — Cleanliness classification for hydraulic fluids*

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

[4] ISO 18413, *Hydraulic fluid power — Cleanliness of parts and components — Inspection document and principles related to contaminant collection, analysis and data reporting*

[5] ISO 21018-1, *Hydraulic fluid power — Monitoring the level of particulate contamination of the fluid — Part 1: General principles*

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