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Aerospace series — Hydraulic filter elements — Test methods —

Part 5: Resistance to flow fatigue

Série aérospatiale — Eléments filtrants hydrauliques — Méthode d'essais —

Partie 5: Résistance aux variations cycliques de débit

Reference number
ISO 14085-5:2015(E)

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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 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: 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.

Different principles are used to control the contamination level of the fluid by removing solid contaminant particles; one of them uses 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.

The effectiveness of the filter element in controlling contaminants is dependent on its design and its sensitivity to any dynamic operating conditions that may stress the filter element and cause damage to it, especially as it becomes clogged and the differential pressure rises.

This part of ISO 14085 provides a procedure to determine the ability of a filter element, under increasing differential pressures, to withstand dynamic operating conditions by evaluating its remaining integrity and performance after being subjected to cyclic flow variations.

Aerospace series — Hydraulic filter elements — Test methods —

Part 5:
Resistance to flow fatigue

1 Scope

This part of ISO 14085 specifies a method for determining the resistance of a filter element to flow fatigue caused by varying flow through the filter in various stages of the filter contaminant loading process. The filter is subjected to a uniform varying flow rate for a specified number of cycles, at a number of predetermined differential pressures.

Although the number of cycles and differential pressure conditions used in this part of ISO 14085 is meant to simulate possible service conditions, this part of ISO 14085 is not intended to qualify a filter element under replicate conditions of service; this can only be done by a specific test protocol developed for the purpose, including actual conditions of use, for example the operating fluid, contamination, and exact cyclic flow conditions.

This part of ISO 14085 establishes a method for verifying the ability of a filter element to withstand the stress caused by cyclic differential pressures induced by a variable flow rate.

The test data resulting from application of this part of ISO 14085 can be used to compare the performance 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 1219-1,*Fluid power systems and components — Graphic symbols and circuit diagrams — Part 1: Graphic symbols for conventional use and data-processing applications*

ISO 2942, *Hydraulic fluid power — Filter elements — Verification of fabrication integrity and determination of the first bubble point*

ISO 2943, *Hydraulic fluid power — Filter elements — Verification of material compatibility with fluids*

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

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

ISO 14085-3, *Aerospace series — Hydraulic filter elements - Test methods — Part 3: Filtration efficiency and retention capacity*

3 Terms and definitions

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

3.1
clean assembly differential pressure
difference between the tested component inlet and outlet pressure as measured with a clean filter housing containing a clean filter element

3.2
clean element differential pressure
differential pressure of the clean element at rated flow, calculated as the difference between the *clean assembly differential pressure* (3.1) and the housing differential pressure

3.3
differential pressure
Δp
difference between the inlet and outlet pressures of the component under test, as measured under specified conditions

3.4
filter element resistance to flow fatigue
ability of a filter element to resist structural failure or performance degradation due to flexing caused by cyclic system flow rate conditions

3.5
housing differential pressure
differential pressure (3.3) of the filter housing without an element

3.6
rated flow rate
maximum design flow rate for the filter element as specified by the manufacturer

3.7
terminal element differential pressure
maximum *differential pressure* (3.3) across the filter element as designated by the manufacturer to limit useful performance

4 Graphic symbols and circuit diagrams

Graphic symbols are used in accordance with ISO 1219-1.

5 Test equipment and supplies

5.1 Pressure-sensing and recording instruments, shall have a frequency response sufficient to measure the full pressure-versus-time curve (see Figure 1).

5.2 Flow fatigue cycle test stand, shall be capable of varying the test flow rate between 0 l/min up to the rated or maximum test flow rate, within the requirements of Figure 1. Use a test stand similar to that depicted in Figure 2.

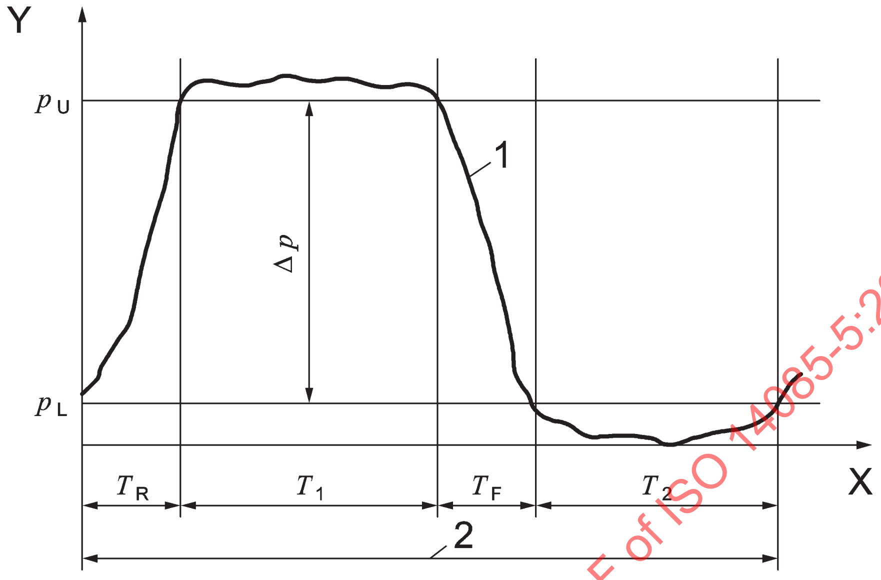
5.3 Test filter housing, shall be used as recommended by the filter manufacturer and modified as needed to ensure that fluid cannot by-pass the filter element.

5.4 Test fluid, shall be compatible with the filter element materials of construction. If necessary, the compatibility of the fluid and filter element materials of construction can be verified in accordance with ISO 2943.

NOTE A fluid viscosity between 14 mm^2/s and 32 mm^2/s at the test temperature is recommended; unless otherwise agreed between the parties involved.

5.5 Cycle counting device, capable of recording the number of flow fatigue cycles.

5.6 Test contaminant: Use ISO Fine Test Dust (ISO FTD), grade A2 in accordance with ISO 12103-1.



Key

1 actual test pressure (kPa)

2 one cycle test time (s): T

X time (s)

Y pressure (kPa)

p_L lower test pressure: $p_L \leq 10\ \%\ p_u$

p_u upper test pressure: tolerance on p_u is $-0\ \%/+10\ \%$

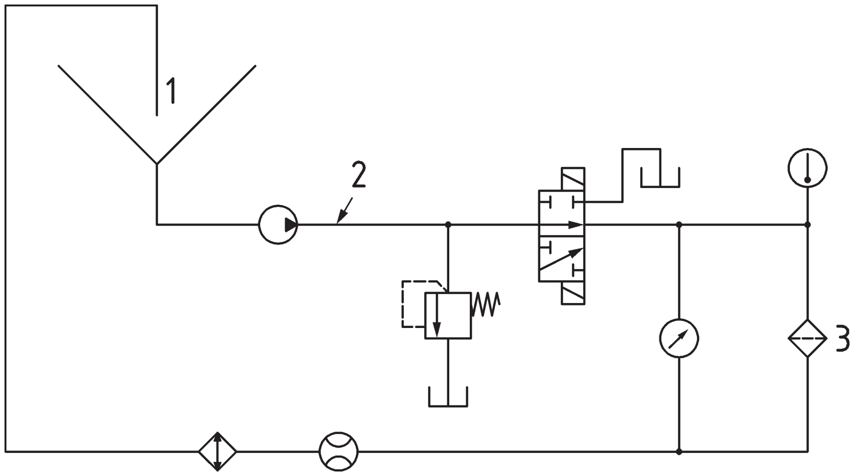
T_R rise time: $T_R = (15\ \% \pm 5\ \%)T$

T_1 time at pressure: $T_1 = (35\ \% \pm 5\ \%)T$

T_F fall time: $T_F = (15\ \% \pm 5\ \%)T$

T_2 time at lowest test pressure: $T_2 = (35\ \% \pm 5\ \%)T$

Figure 1 — Flow fatigue cycle waveform



Key

1 contaminant injection in reservoir

2 alternate point for contaminant injection

3 test filter

Figure 2 — Typical filter element flow fatigue cycle test stand circuit

NOTE The circuit in this figure is simplified and includes only the basic components for conducting the test specified in this part of ISO 14085. Other components or additional circuitry (e.g. a clean-up filter loop) might be necessary. In all cases, connection lines to test filter should be as short as possible, and piping should be rigid to limit initial pressure peak and prevent pressure overshoot

6 Accuracy of measurements and test conditions

Instruments used to measure test parameters shall provide the reading accuracy specified in Table 1. Test conditions shall be maintained within the tolerances specified in Table 1.

Table 1 — Instrument accuracy and test condition variation

Test parameter	Unit	Measurement accuracy	Allowable test condition variations
Flow rate	l/min	±2 %	±10 %
Differential pressure	kPa	±2 %	−0 %/+10 %
Temperature	°C	±1 °C	±3 °C
Cycle rate	Hz	—	±10 %

7 Test procedure

7.1 Subject the filter element under test to a fabrication integrity test in accordance with ISO 2942.

7.2 Disqualify from further testing any element that fails to pass the criteria specified in ISO 2942.

7.3 Install the test filter housing in the flow fatigue cycle test stand (see 5.2 and Figure 2).

7.4 Plot the housing differential pressure versus flow rate. Determine the test filter housing differential pressure from at least 25 % up to 100 % of the maximum test flow rate at the test temperature selected. Record the results into column 3 of Table 3.

7.5 Install the filter element in the test filter housing.

7.6 Calculate and plot the final assembly differential pressure curve corresponding to the predetermined terminal element differential pressure plus the housing differential pressure at the same flow rates as used in 7.4. Record the results on the report sheet into Column 4 of Table 3.

7.7 Calculate the clean element differential pressure at maximum flow, then determine the element differential pressures and number of cycles required for testing. Use the conditions given in Table 2, unless otherwise specified. Enter the values into columns 2 and 5 of Table 3.

Table 2 — Specified flow fatigue duty cycle

Test condition	Element differential pressure	Number of flow fatigue cycles
1	2 × clean element Δp at max flow	90 000
2	4 × clean element Δp at max flow	8 000
3	Terminal element Δp	2 000
4	System pressure (for non-by-pass type filters) or maximum full-flow by-pass Δp (for by-pass type filters)	500

7.8 Complete columns 2, 3, and 5 in Table 3 using the information from 7.4, 7.6, and 7.7. Calculate the assembly differential pressures required for the flow cycling by completing column 4 in Table 3.

Table 3 — Test flow fatigue duty cycle

Test condition	Element Δp calculated from Table 2, column 2	Housing Δp at maximum test flow	Assembly Δp for fatigue testing (column 2 plus column 3)	Number of flow fatigue cycles from Table 2, column 3
1				
2				
3				
4				

7.9 Set the system flow rate to the maximum test flow rate, then add test contaminant until the assembly differential pressure for test condition 1 (from Table 3) is reached.

NOTE If it is advantageous to start flow cycling while loading the filter element to the designated assembly differential pressure, ensure that the cycle counting device is reset to zero before proceeding to 7.10.

7.10 Carry out the flow fatigue cycle test for test condition 1. Each flow fatigue cycle shall consist of varying the flow rate through the filter element from 0 l/min to a flow rate between 25 % and 100 % of the maximum test flow rate and then back to 0 l/min, while maintaining the required assembly differential pressure and differential-pressure-versus-time trace specified in Figure 1. The frequency of the test cycle rate shall be selected from the range between 0,2 Hz to 1 Hz (inclusive) and shall remain constant within the tolerance given in Table 1 throughout the test.

NOTE 1 The filter element might need more contaminant to maintain the designated assembly differential pressure at lower flow rates such as 25 % of the rated flow rate. However, because the filter element can experience particle desorption due to the variation in flow rate, it is suggested that initial contaminant be injected at the minimum or intermediate flow rate (i.e. 25 % or other percentage of rated flow rate) until the designated assembly differential pressure is reached. This approach can minimize the total amount of contaminant used during the duration of the test, as the differential pressure can be maintained by increasing the flow rate instead of adding more contaminant.