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Hydraulic fluid power — Filter elements — Determination of resistance to flow fatigue using particulate contaminant

Transmissions hydrauliques — Éléments filtrants — Détermination de la résistance à la fatigue due au débit en utilisant un contaminant particulaire

Reference number
ISO 3724:2007(E)

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Foreword

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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 3724 was prepared by Technical Committee ISO/TC 131, *Fluid power systems*, Subcommittee SC 6, *Contamination control*.

This second edition cancels and replaces the first edition (ISO 3724:1976), which has been technically revised.

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. Filters maintain fluid cleanliness by removing insoluble contaminants. The filter element is a porous device that performs the actual process of filtration.

The effectiveness of the filter element in controlling contaminants is dependent upon its design and its sensitivity to any unsteady operating conditions that can stress and cause damage to the filter element.

Hydraulic fluid power — Filter elements — Determination of resistance to flow fatigue using particulate contaminant

1 Scope

This International Standard specifies a method for determining the resistance of a hydraulic filter element to flow fatigue after it has been loaded with particulate contaminant and subjected to a uniform varying flow rate and predetermined maximum element differential pressure.

It establishes a uniform method for verifying the ability of a filter element to withstand the flexing caused by cyclic differential pressures induced by a variable flow rate.

NOTE Annex A summarizes data from a round robin test performed to verify the procedure specified in this International Standard.

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 1219-1, *Fluid power systems and components — Graphic symbols and circuit diagrams — Part 1: Graphic symbols for conventional use and data-processing applications*

ISO 1219-2, *Fluid power systems and components — Graphic symbols and circuit diagrams — Part 2: Circuit diagrams*

ISO 2941[1)], *Hydraulic fluid power — Filter elements — Verification of collapse/burst pressure rating*

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[2)], *Fluid power systems and components — Vocabulary*

1) To be published. (Revision of ISO 2941:1974)

2) To be published. (Revision of ISO 5598:1985)

3 Terms and definitions

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

3.1
filter element resistance to flow fatigue
ability of a filter element to resist structural failure due to flexing caused by cyclic system flow rate conditions

3.2
maximum assembly differential pressure
Δp_A
sum of the housing differential pressure and the maximum element differential pressure

3.3
housing differential pressure
Δp_H
differential pressure of the filter housing without an element

3.4
maximum element differential pressure
Δp_E
maximum differential pressure across the filter element designated by the manufacturer as the limit of useful performance

4 Graphic symbols and circuit diagrams

Graphic symbols used in this International Standard are in accordance with ISO 1219-1 and circuit diagrams in accordance with ISO 1219-2.

5 Test apparatus

5.1 Pressure-sensing and recording instruments, with a frequency response capable of measuring the full pressure-versus-time curve (see Figure 1).

5.2 Flow fatigue cycle test stand, capable of varying the test flow rate from 0 l/min up to the rated flow rate (see Figures 1 and 2).

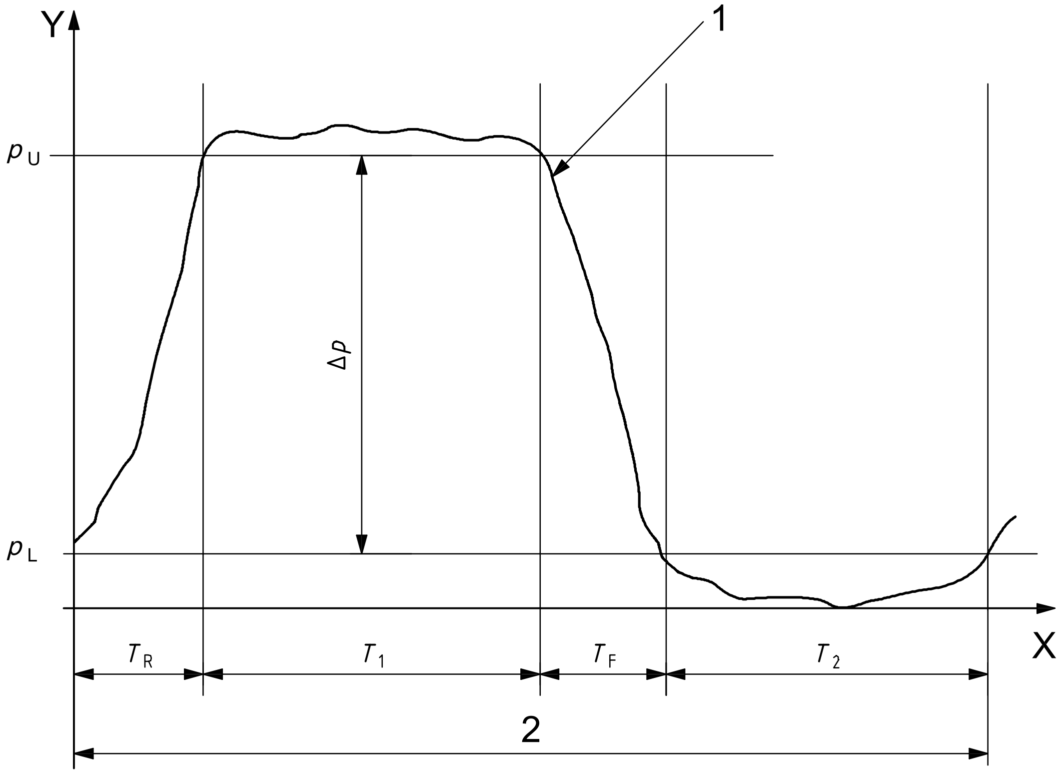
5.3 Test filter housing, capable of ensuring that the fluid cannot bypass the filter element. The filter shall be capable of being modified to suit this purpose.

5.4 Test fluid, with a viscosity between 14 mm^2/s and 32 mm^2/s at the test temperature. The compatibility of the fluid and filter element material shall be verified in accordance with ISO 2943. Any fluid that is compatible with the filter element material may be used.

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

5.6 Inert particulate contaminant, not able to add strength to the filter element, used to load the filter element being evaluated.

NOTE Test dust according to ISO 12103-1 is suitable.



Key

X time (s)

Y pressure (kPa)

1 actual test pressure (kPa)

2 one test cycle, T

p_L lower test pressure; $p_L \leqslant 10\ \%\ p_U$

p_U upper test pressure; tolerance on p_U is ± 10 %

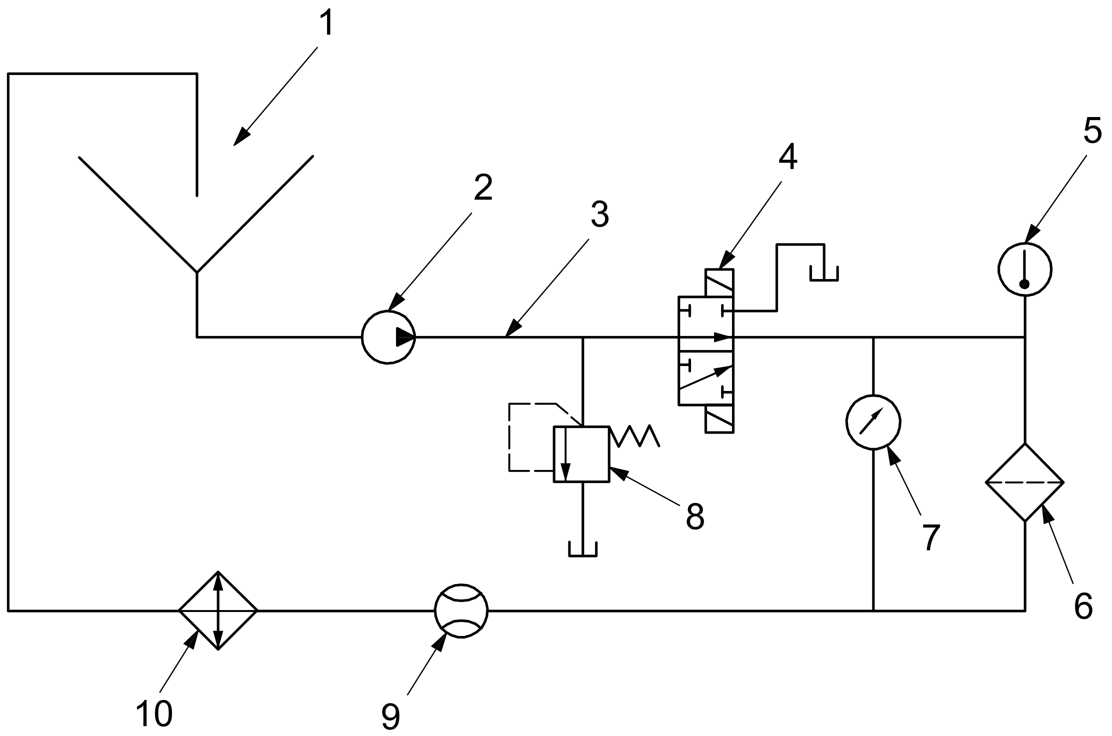
T_R rise time; $T_R = (15 \pm 5)\ \%T$

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

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

T_2 time without pressure; $T_2 = (35 \pm 5)\ \%T$

Figure 1 — Flow fatigue cycle test waveform



Key

1 contaminant injection
2 system pump
3 alternative point of contaminant injection
4 cycling valve
5 temperature sensor
6 filter under test
7 differential pressure transducer
8 relief valve
9 flow meter
10 heat exchanger

NOTE The circuit in this figure is simplified and includes only the basic components needed for conducting the test specified in this International Standard. Other components or additional circuitry (e.g. clean-up filter loop) can be used.

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

6 Accuracy of measurements and test conditions

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

Table 1 — Instrument accuracy and allowed test condition variation

Test condition	SI unit	Instrument accuracy — Tolerance on reading	Allowed test condition variation
Flow rate	l/min	± 2 %	± 10 %
Differential pressure	kPa	± 2 %	± 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 curve of housing differential pressure (Δp_H) versus flow rate (q). Determine the test filter housing differential pressure from at least 25 % up to 100 % of the rated flow rate at the test temperature selected. Record the results in the test report (see Table 2).

7.5 Install the filter element in the test filter housing.

7.6 Calculate and plot the maximum assembly differential pressure (Δp_A) curve, corresponding to the predetermined maximum element differential pressure (Δp_E) plus the housing differential pressure (Δp_H), at the same flow rates as those given in 7.4. Record the results in the test report (see Table 2).

7.7 Add the test contaminant until the maximum assembly differential pressure (Δp_A) is reached.

NOTE 1 The filter element will need more contaminant in order for the maximum element differential pressure to be reached at 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 (that is 25 % or other percentage of rated flow rate) until the maximum assembly differential pressure is reached. This approach can minimize the total amount of contaminant used throughout the test, as the differential pressure can be maintained by increasing the flow rate instead of adding more contaminant.

If it is advantageous to start flow fatigue cycling while loading the filter element to the maximum assembly differential pressure, ensure that the cycle counting device is reset to zero before proceeding to 7.8.

Initially, contaminant should be added in a uniform manner. For incremental injections, a mass of 5 % of the estimated filter element contaminant capacity per injection is recommended. Adjustments to the quantities of contaminant added and time intervals between injections may be required.

NOTE 2 The test can be interrupted and restarted as necessary. If the test is interrupted, additions of contaminant will most likely be required to regain the maximum assembly differential pressure.

7.8 Begin the flow fatigue cycle test. 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 rated flow rate and then back to 0 l/min, while maintaining the differential pressure-versus-time trace specified in Figure 1. The frequency of the test cycle rate shall be selected from the range 0,2 Hz to 1 Hz (inclusive) and shall remain constant within the tolerances given in Table 1 throughout the test.

A relief valve may be used (see Figure 2) and adjusted as necessary to limit peak pressure to the maximum assembly differential pressure within a tolerance of ± 10 %, as specified in the waveform shown in Figure 1. Contaminant may also be added periodically during the test to maintain differential pressure.

7.9 Monitor and control the assembly differential pressure by reducing or increasing the flow rate, as needed, between 25 % and 100 % of the rated flow rate.

7.10 Subject the filter element to the required number of flow fatigue cycles.

7.11 Obtain and present a typical differential pressure-versus-time trace for at least one cycle (see Figure 1).

7.12 Subject the filter element to a collapse/burst test in accordance with ISO 2941, with the exception that the bubble point test before the collapse/burst test is not required.

