INTERNATIONAL STANDARD

ISO 23181

First edition
2007-08-15

Hydraulic fluid power — Filter elements — Determination of resistance to flow fatigue using high viscosity fluid

Transmissions hydrauliques — Éléments filtrants — Détermination de la résistance à la fatigue due au débit en utilisant un fluide à haute viscosité

Reference number
ISO 23181:2007(E)

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

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 23181 was prepared by Technical Committee ISO/TC 131, *Fluid power systems*, Subcommittee SC 6, *Contamination control*.

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. The flow fatigue test procedure using high viscosity fluid specified in this International Standard can be used when the same element needs to be subjected to further testing, for example a multi-pass test, after the flow fatigue test has been applied in order to meet a purchaser's acceptance criteria. In addition, this International Standard can be used to simulate start-up conditions of mobile hydraulic equipment by using a high viscosity fluid to generate the required differential pressure. The attention of users of this International Standard is drawn to the fact that round robin testing has shown that flow fatigue resistance characteristics determined in accordance with this International Standard differ from characteristics determined in accordance with ISO 3724.

Hydraulic fluid power — Filter elements — Determination of resistance to flow fatigue using high viscosity fluid

1 Scope

This International Standard specifies a method for determining the resistance of a hydraulic filter element to flow fatigue when subjected to high viscosity fluid, using a uniformly varying flow rate up to a predetermined maximum differential pressure and a controlled waveform.

It establishes a 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 See the Introduction of this International Standard for information about its applicability.

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 3448, *Industrial liquid lubricants — ISO viscosity classification*

ISO 4406, *Hydraulic fluid power — Fluids — Method for coding the level of contamination by solid particles*

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

3.5
high viscosity fluid
fluid that is classified by its manufacturer as having a viscosity greater than or equal to 198 mm^2/s at 40 °C

NOTE This viscosity level is classified as ISO VG 220 in accordance with ISO 3448.

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

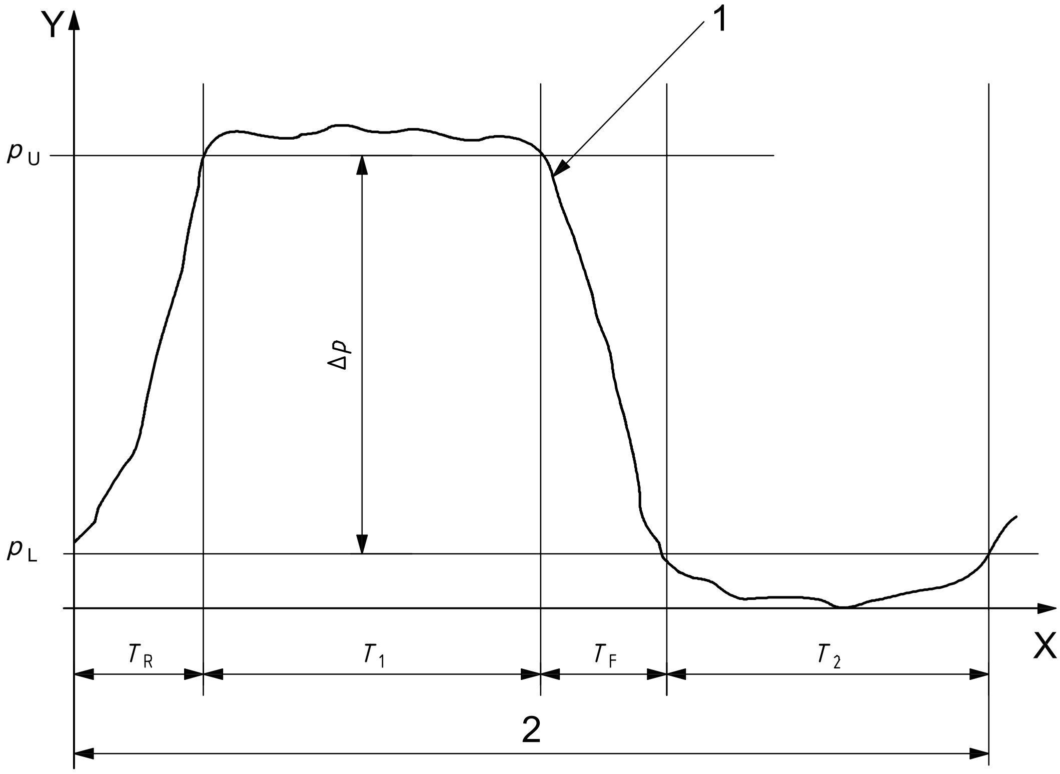
5.1 Pressure-sensing and recording instruments, with a frequency response capable of measuring the full pressure-versus-time curve (see Figure 1).

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 equal to or greater than 198 mm^2/s at 40 °C (ISO VG 220, in accordance with ISO 3448). The viscosity of the test fluid shall provide the desired maximum element differential pressure at the test temperature and flow rate selected. Care shall be taken to ensure that the fluid chosen does not create adverse suction conditions in the main pump, otherwise cavitation could occur. The fluid in the system should be cleaned to a solid contamination level of 18/16/13 or cleaner in accordance with ISO 4406 prior to installing the filter element under test in the circuit. 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.



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 $\pm$ 10 %

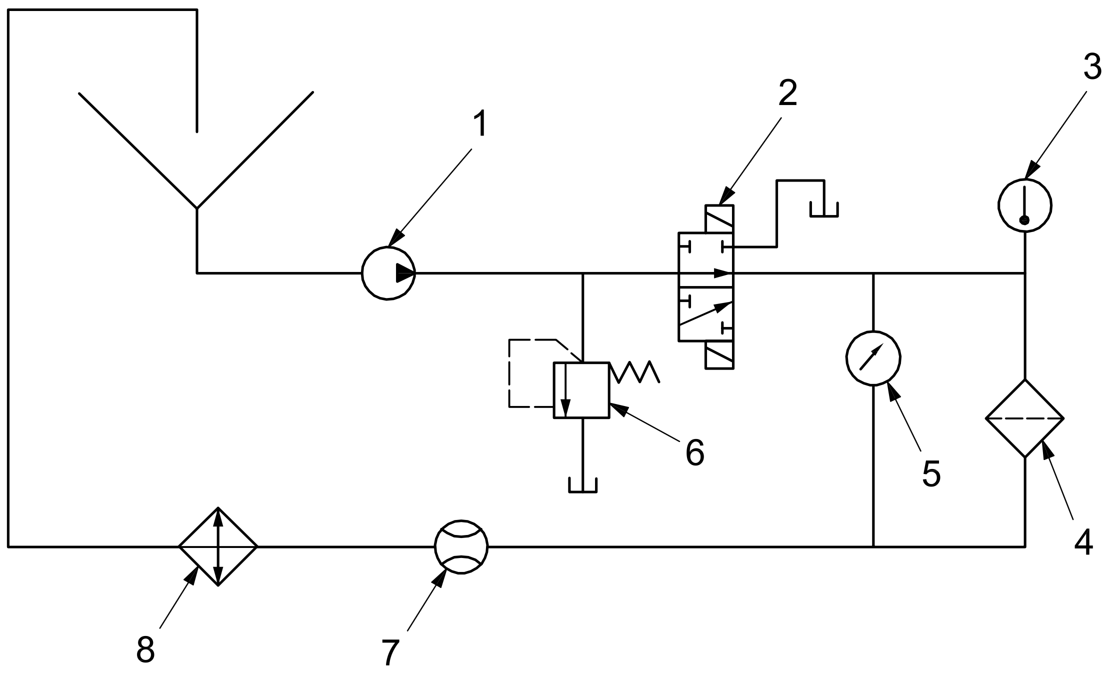
T_R rise time; $T_R = (15 \pm 5)\ \%T$

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 system pump
2 cycling valve
3 temperature sensor
4 filter under test
5 differential pressure transducer
6 relief valve
7 flow meter
8 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 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). Plot the curve of housing differential pressure (Δp_H) versus flow rate (q) for the test filter housing (Curve 1).

7.5 Install the filter element in the test filter housing. Determine the assembly differential pressure (Δp_A) at the same flow rate as that used in 7.4. Record the results in the test report (see Table 2). Plot the curve of assembly differential pressure (Δp_A) versus flow rate (q) (Curve 2).

7.6 Calculate and plot the differential pressure curve of the filter element by subtracting the values used to produce Curve 1 (see 7.4) from those used to produce Curve 2 (see 7.5). Determine from the resulting curve the flow rate required to reach the predetermined maximum element differential pressure (Δp_E), and record the results in the test report (see Table 2). Determine from Curve 2 the maximum assembly differential pressure (Δp_A), and record the results in the test report (see Table 2).

7.7 Set the flow rate at the value determined in 7.6, and check that the maximum assembly differential pressure (Δp_A) has been reached. If this cannot be achieved, repeat steps 7.4 to 7.6, either at a lower test temperature or with a fluid that has a higher viscosity.

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 not exceeding 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.

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 throughout the entire duration of 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 (Δp_A), within a tolerance of ± 10 %, as specified in the waveform shown in Figure 1.

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.

8 Criteria for acceptance

The filter element shall be accepted if it passes the collapse/burst test in accordance with ISO 2941, after the completion of the required number of flow fatigue cycles and with the exception given in 7.12.

9 Data presentation

As a minimum, present all of the test data and calculation results mentioned in Clause 7. The format of the test report should be that of the example given in Table 2.