INTERNATIONAL STANDARD

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Hydraulic fluid power — Sequence of tests for verifying performance characteristics of filter elements

Transmissions hydrauliques — Ordre des essais pour la vérification des caractéristiques de performance des éléments filtrants

Reference number
ISO 11170:2013(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.

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 11170 was prepared by Technical Committee ISO/TC 131, *Fluid power systems*, Subcommittee SC 6, *Contamination control*.

This third edition cancels and replaces the second edition (ISO 11170:2003), which has been technically revised.

Introduction

In hydraulic fluid power systems, power is transmitted and controlled through a liquid under pressure within a closed circuit. 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 to the components. The extent of contamination in the fluid has a direct bearing on the performance and reliability 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.

Different principles are used for this purpose; one of these 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 performance of filter elements is measured by testing, and a series of International Standards has been developed to determine performance under specified conditions (see Clause 2). To give a greater level of assurance for a filter element's fitness for duty, most if not all of these tests should be used in a verification programme.

This International Standard provides an approval or verification protocol that features all of the current International Standards for filter testing.

Hydraulic fluid power — Sequence of tests for verifying performance characteristics of filter elements

1 Scope

This International Standard defines a sequence of tests for verifying filter elements. It can be used to check their hydraulic, mechanical and separation characteristics.

This International Standard is not intended to qualify a filter for a particular duty or replicate conditions of service. This can only be done by a specific test protocol developed for the purpose, including actual conditions of use (e.g. the operating fluid).

The procedure in this International Standard is applicable to individual fluids or types of fluids that have similar chemistry.

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 2941, *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 3723, *Hydraulic fluid power — Filter elements — Method for end load test*

ISO 3724, *Hydraulic fluid power — Filter elements — Determination of resistance to flow fatigue using particulate contaminant*

ISO 3968, *Hydraulic fluid power — Filters — Evaluation of differential pressure versus flow characteristics*

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

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

ISO 16889, *Hydraulic fluid power — Filters — Multi-pass method for evaluating filtration performance of a filter element*

ISO 23181, *Hydraulic fluid power — Filter elements — Determination of resistance to flow fatigue using high viscosity fluid*

3 Terms and definitions

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

4 Test elements

The filter elements selected for verification testing shall be representative of normal product stock filter elements of the same model.

Some tests are destructive or make the filter element unsuitable for further tests. It is therefore essential to have available a sufficient number of filter elements, because at least three elements shall be tested.

5 Test procedure

5.1 General

5.1.1 Completion of the procedure specified in this International Standard provides data on the following filter element characteristics:

a) fabrication integrity (see ISO 2942);

b) material compatibility with fluids (see ISO 2943);

c) filtration efficiency (see ISO 16889);

d) contaminant retention capacity (see ISO 16889);

e) collapse/burst pressure rating (see ISO 2941);

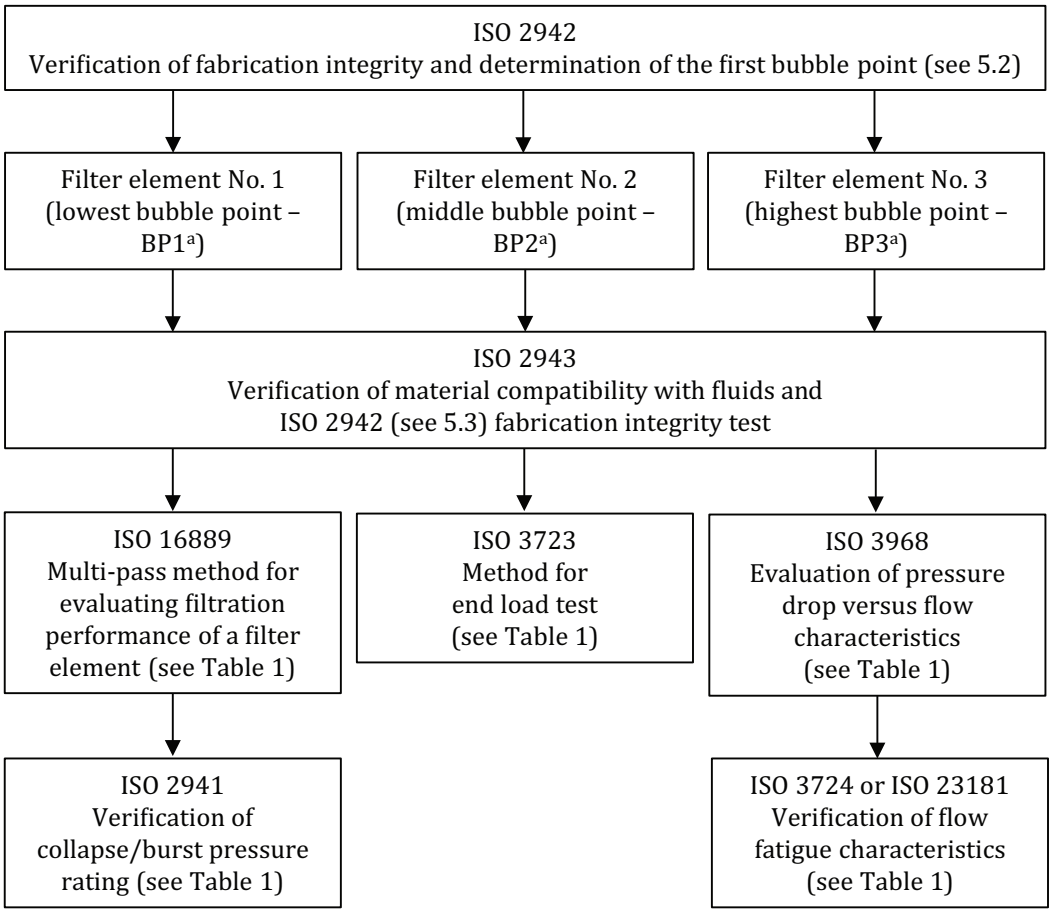
f) pressure drop versus flow characteristics (see ISO 3968);

g) flow fatigue characteristics (see ISO 3724 or ISO 23181); and

h) end load rating (see ISO 3723); if it can be demonstrated that this test is not relevant to the design of the filter element being tested, then the tests on element no. 2 shall be omitted.

5.1.2 Tests shall be run in accordance with the sequence given in Figure 1 (see 5.2.4 for the numbering of the filter elements) and in accordance with the requirements given in Table 1.

NOTE The purpose of the sequence of the tests is to minimize the number of tests and to ensure that the verification is complete.



a See 5.2.4.

Figure 1 — Sequence of testing

Table 1 — Test requirements in addition to fabrication integrity and material compatibility tests

Test	Test procedure	Acceptance criteria or data to be reported
Filter element no. 1 (BP1[a])		
Filtration efficiency	Use ISO 16889, excluding initial fabrication integrity test.	Particle sizes in µm(c) for the values of $\beta_{x(c)}$ as defined in ISO 16889
Contaminant retention capacity	Use ISO 16889.	Value of C_R.
Collapse/burst pressure rating	Use ISO 2941, excluding initial fabrication integrity test.	No visual evidence of structural, seal or filter medium failure.
		No abrupt decrease in the slope of the differential pressure versus contaminant mass added curve.
Filter element no. 2 (BP2[a])		
End load test	Use ISO 3723, excluding initial fabrication integrity test and material compatibility test.	No visual evidence of structural, seal or filter medium failure.
		No abrupt decrease in the slope of the differential pressure versus contaminant mass added curve.
Filter element no. 3 (BP3[a])		
Pressure drop versus flow characteristics	Use ISO 3968.	Δp curve as a function of flow rate.
Flow fatigue characteristics	Use ISO 3724 or ISO 23181, excluding initial fabrication integrity test.	No visual evidence of structural, seal or filter medium failure.
		No abrupt decrease in the slope of the differential pressure versus contaminant mass added curve.

[a] See 5.2.4.

5.2 Fabrication integrity test

5.2.1 Verify the fabrication integrity of each of the three filter elements in accordance with ISO 2942 and disqualify from further testing any filter elements that fail.

5.2.2 Record the pressure value at the first bubble point for each filter element.

5.2.3 Dry the filter elements either in a heating vacuum chamber, or air-dry them in a suitable, well-ventilated area, preferably in a fume cabinet.

WARNING — Exercise care when drying filter elements that have been rinsed with solvents that have a low flash point.

5.2.4 Identify the three filter elements in ascending order of the first bubble point pressure, identifying the filter element that has the lowest bubble point pressure (BP1) as no. 1 and the filter element with the highest bubble point pressure (BP3) as no. 3, with BP1 < BP2 < BP3.

Ensure that the identification mark chosen does not conflict with other markings on the filter element.

5.3 Material compatibility test

WARNING — Refer to local safety requirements.

5.3.1 Immerse the filter elements in accordance with the requirements of the hot soak portion of ISO 2943.

5.3.2 Conduct a visual examination of the filter elements. There shall be no evidence of structural, seal or filter medium failure. Disqualify any element that has been damaged as a result of the test.

5.3.3 Rinse the filter elements three times by submerging the filters for a period of 10 min in a reservoir containing filtered solvent that is compatible with and miscible with both the previous test fluid and the bubble point test fluid. The contamination code level of the solvent shall be equal to or cleaner than –/11/9 in accordance with ISO 4406.

Then rinse the filter elements inside and outside by covering the entire filter element surface with a jet of the same solvent filtered through a 0,8 µm membrane disc. Perform this rinsing operation as carefully as possible so as not to damage the filter element. The use of needle-shaped jets should be avoided, as they can damage the filter medium. A fan-shaped jet is recommended.

5.3.4 Dry the filter elements in accordance with 5.2.3.

WARNING — Exercise care when drying filter elements that have been rinsed with solvents that have a low flash point.

5.3.5 Verify the fabrication integrity of each of the three filter elements in accordance with ISO 2942. Disqualify any element that fails the ISO 2942 criteria. Retest other elements, reporting all elements that fail.

5.3.6 Record the pressure value at the first bubble point for each filter element.

5.3.7 Dry the filter elements in accordance with 5.2.3.

WARNING — Exercise care when drying filter elements that have been rinsed with solvents that have a low flash point.

5.4 Other tests

The rest of the tests shall be conducted on filter elements nos. 1, 2 and 3 in the order specified in Figure 1 and in accordance with the requirements of Table 1. The order in which the three filter elements are tested is not important (for example, filter element no. 2 may be tested before filter element no. 1), as long as the tests on each filter element follow the order specified in Figure 1.

6 Test report

Prepare a test report in accordance with the reporting requirements of the respective International Standard for each test carried out. The test report shall include all of these specific test reports and the related test values.

7 **Identification statement** (reference to this International Standard)

Use the following statement in test reports, catalogues and sales literature when electing to comply with this International Standard:

"Sequence of tests for verifying the performance characteristics of hydraulic filter elements performed in accordance with ISO 11170:2013, *Hydraulic fluid power — Sequence of tests for verification performance characteristics of filter elements.*"

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