INTERNATIONAL STANDARD

ISO 2941

Second edition
2009-04-01

Hydraulic fluid power — Filter elements — Verification of collapse/burst pressure rating

Transmissions hydrauliques — Éléments filtrants — Vérification de la pression d'écrasement/éclatement

Reference number
ISO 2941:2009(E)

PDF disclaimer

COPYRIGHT PROTECTED DOCUMENT

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

Contents

Page

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 2941 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 2941:1974), of which Clauses 5 and 6 have been technically revised and to which informative Annexes A, B and C have been added.

Introduction

In hydraulic fluid power systems, power is transmitted and controlled through a liquid under pressure within an enclosed circuit.

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

The capability of the filter element to maintain a specified fluid cleanliness level depends on its performance and structural integrity and its ability to withstand non-steady-state conditions (e.g. cold starts and decompression surges). The filter element's resistance to collapse or burst is a measure of its ability to withstand such effects.

Hydraulic fluid power — Filter elements — Verification of collapse/burst pressure rating

1 Scope

This International Standard specifies a method for verifying the collapse/burst pressure rating of a hydraulic fluid power filter element, i.e. the capability of a filter element to withstand a designated differential pressure at the normal (i.e., intended direction of) flow, by means of pumping contaminated fluid through the filter element until either collapse/burst occurs or the maximum expected differential pressure is reached without element failure.

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 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*

3 Terms and definitions

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

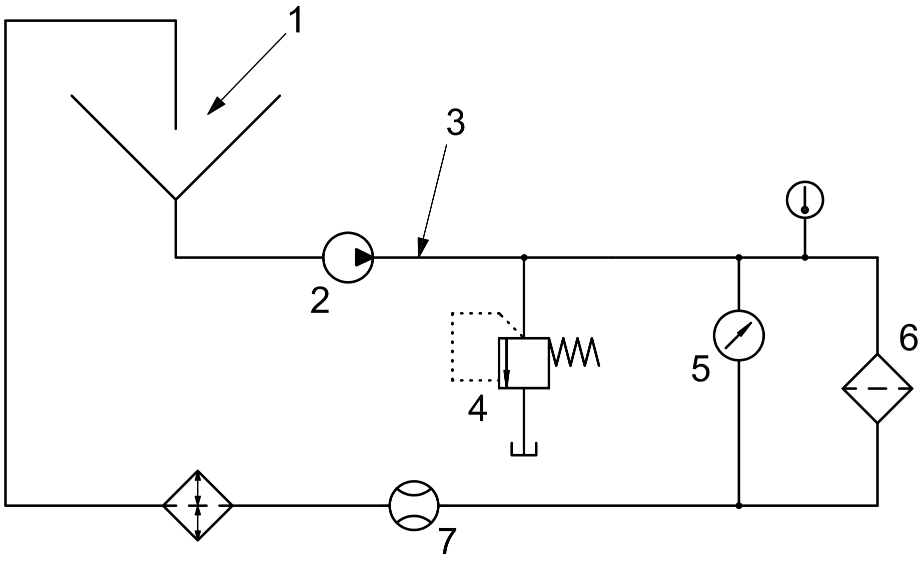
4 Graphic symbols

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

5 Test circuit and equipment

5.1 Test circuit

Figure 1 shows the arrangement of a typical circuit for the collapse/burst test described in Clause 6.



Key

1 contamination injection site
2 system pump
3 alternate contamination injection site
4 pressure relief valve
5 differential pressure gauge
6 filter under test
7 flowmeter

Figure 1 — Typical circuit for collapse/burst test

5.2 Apparatus

The following test equipment shall be used:

5.2.1 Test filter housing (recommended by the filter manufacturer), modified as necessary to ensure that fluid cannot bypass the filter element.

5.2.2 Pump and **motor**, capable of maintaining the flow of the fluid in the test circuit at a pressure greater than the differential pressure required.

The pump and motor drive system shall maintain a constant uniform flow rate within a tolerance of $\pm$ 5 % throughout the entire test. Positive and/or negative fluctuations in flow rate lead to inaccurate results.

5.2.3 Reservoir, of sufficient size to contain the fluid in the test circuit, designed to keep the contamination in suspension; dead legs and quiescent areas shall be avoided.

A cylindrical reservoir with a conical bottom has been shown to satisfy this requirement. The return line to the reservoir shall be below the fluid level to prevent aeration of the fluid.

5.2.4 Connectors and **valves**, as necessary to control the flow of fluid through the filter.

A pressure relief valve is optional.

5.2.5 Differential pressure transducer, capable of registering the expected differential pressure.

5.2.6 Electronic strip chart-recording device, with a response rate of 40 Hz to 100 Hz, or an equivalent recording device (see Annex A for recommendations for the electronic strip chart-recording device).

NOTE Optionally, an online automatic particle counter or contamination level indicator can be installed in the system, downstream from the filter under test.

5.3 Fluid

A fluid compatible with the filter element material, as determined in accordance with ISO 2943, shall be used.

5.4 Contaminant

The test contaminant shall be ISO 12103-1 A2 (ISO Fine Test Dust) or A3 (ISO Medium Test Dust) or another inert particulate contaminant. The contaminant shall not add to the strength of the element under test.

5.5 Instrument accuracy and test conditions

Instrument accuracy and test conditions shall be maintained within the limits given in Table 1.

Table 1 — Instrument accuracy and test condition variation

Test parameter	Unit	Instrument accuracy of reading	Allowed test condition variation
Differential pressure	Pa or kPa (bar)	± 5 %	—
Injection flow rate	mL/min	± 2 %	± 5 %
Test flow rate	L/min	± 2 %	± 5 %
Kinematic viscosity [a]	mm^2/s	± 2 %	—
Mass	g	± 0,1 mg	—
Temperature	°C	± 1 °C	± 2 °C
Time	s	± 1 s	—
Injection system volume	L	± 2 %	—
Filter test system volume	L	± 2 %	± 5 %

[a] 1 mm^2/s = 1 cSt (centistoke).

6 Test procedure

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

6.2 Disqualify from further testing any element that does not meet or exceed the manufacturer's specified minimum first bubble pressure. If the element meets or exceeds the manufacturer's rated minimum first bubble pressure, allow the fluid used in the fabrication integrity test to evaporate from the element, or rinse the element with the fluid being used in the collapse/burst test procedure.

6.3 Install the filter housing in the collapse/burst test circuit at the location shown in Figure 1.

6.4 Determine the differential pressure across the empty filter housing at either the manufacturer's rated nominal flow rate or at a value between 50 % and 80 % of the nominal flow rate, and at either a selected test temperature between 15 °C and 40 °C or at a specified test temperature, and record.

6.5 Install the element in the test filter housing.

6.6 Subject the element to the flow rate and temperature determined in 6.4. Maintain a uniform flow rate throughout the entire test. Maintain the test temperature within a tolerance of ± 2 °C. Record the viscosity of the fluid at the test temperature and the overall differential pressure. The pressure relief valve, if one is installed in the system, should be set at not less than 150 % of the specified final collapse/burst pressure of the element being tested.

6.7 Inject into the system, either continuously or intermittently (sometimes known as "batch loading"), a controlled amount of the test contaminant at a rate that is not greater than 5 % of the element's estimated contaminant capacity, at intervals of at least 2 min, while maintaining the specified test flow rate and test temperature. Record the type of contaminant used. The contaminant used shall be injected in a uniform manner and at a concentration low enough so that the pressure measurement equipment can detect any structural failure.

To reduce testing time, a preload of contaminant equal to 50 % of the element's estimated contaminant capacity may be added, if agreed by the manufacturer.

6.8 Record the flow rate and differential pressure across the filter as a function of contaminant mass added, expressed in grams or units of time, until the differential pressure, expressed in kilopascals, across the element (filter assembly differential pressure minus housing differential pressure) meets or exceeds the specified collapse/burst pressure rating or until failure. If contaminant is added intermittently, wait 2 min after the addition of contaminant before recording the flow rate and differential pressure.

6.9 Subject the filter element to a fabrication integrity test in accordance with ISO 2942, using the same fluid as in 6.1, if physical collapse has not occurred.

6.10 Record the following data:

a) test flow rate;

b) maximum filter-element differential pressure achieved;

c) fluid temperature;

d) type and viscosity at the test temperature of the fluid used in the test circuit;

e) type of contaminant introduced;

f) direction of flow through the element;

g) type of pump.

6.11 If the contaminant fills the filter housing before collapse/burst is achieved, the test shall not be valid.

6.12 Calculate the contaminant mass injection rate, expressed in grams per minute, and multiply the test time, expressed in minutes, by this factor to give the mass of contaminant added.

6.13 Plot the relationship of differential pressure versus contaminant mass added in linear co-ordinate format.

7 Acceptance criteria

The filter element collapse/burst pressure rating shall be verified if

a) there is no visual evidence of failure in the element's structure, filter medium and seals, when tested in accordance with ISO 2942, and

b) there is no abrupt decrease in the slope of the differential pressure versus contaminant mass added curve plotted in 6.13 prior to the specified collapse/burst pressure rating (see Annex C for examples of abrupt decreases in slope). Transients in differential pressure should not be included when evaluating the curve for an abrupt decrease in slope.

8 Reporting

8.1 The test information recorded in the documentation for a filter element tested in accordance with this International Standard shall show

a) the test flow rate;

b) the maximum filter element differential pressure achieved prior to collapse;

c) the fluid temperature;

d) the type and viscosity at the test temperature of the fluid used in the test circuit;

e) the type of contaminant introduced;

f) the direction of flow through the element;

g) the minimum collapse/burst pressure rating.

8.2 The form in Annex B may be used to report the data.

9 Identification statement (reference to this International Standard)

It is strongly recommended to manufacturers who have chosen to conform to this International Standard that the following statement be used in test reports, catalogues and sales literature:

"Filter element collapse/burst pressure rating conform to ISO 2941:2009, *Hydraulic fluid power — Filter elements — Verification of collapse/burst pressure rating*."

Annex A
(informative)

Recommendations for electronic strip chart-recording device used in the ISO 2941 collapse/burst test procedure and typical curves generated by these devices

A.1 General

ISO 2941 requires precision in the measurement of differential pressure, and this is best done using an automatic data recording method, such as a data logger, computer or chart recorder. The response of the transducer/recorder combination should be $>$ 50 Hz to determine when a structural or filter medium failure occurs during the collapse/burst test.

Use of the recording device itself does not assure good results. Care should be taken to ensure that the instrument is properly adjusted. The information in Clause A.2 provides guidance.

A.2 Specific recommendations

A.2.1 Electronic damping of the transducer should be kept to a minimum.

A.2.2 There should be no damping orifices between the transducer and filter inlet line.

A.2.3 Data capture rate and chart speed should be set so that failure of the filter medium, as well as structural failure, can be identified.

A.2.3.1 During the initial part of the test, while the filter element is loading (i.e. up to approximately 10 % of estimated collapse/burst pressure), data capture rate or chart speed should be set at the recording device's slowest speed setting.

A.2.3.2 During the critical portion of the test (i.e. from 10 % of estimated collapse/burst pressure to failure or test pressure), it is recommended that the frequency of data collection should be capable of detecting the failure point; a frequency of data collection of 0,2 Hz or a chart speed of 5 mm/s has been found suitable, depending on the capability of the instrument used.

If contaminant is added intermittently, rather than continuously, it is recommended that the recording device be set to a speed that allows it to register the changes in differential pressure.

Annex B
(informative)

Test data report form

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

Test conditions and equipment

Test flow rate: .... L/min Fluid temperature: .... °C

Maximum filter element differential pressure achieved prior to collapse: .... kPa

Type of contaminant: ....

Direction of flow through the element: ....

Fluid used in the test circuit

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

Filter element

Manufacturer: ....

Manufacturer's identification or part number: ....

Batch number/date code: ....

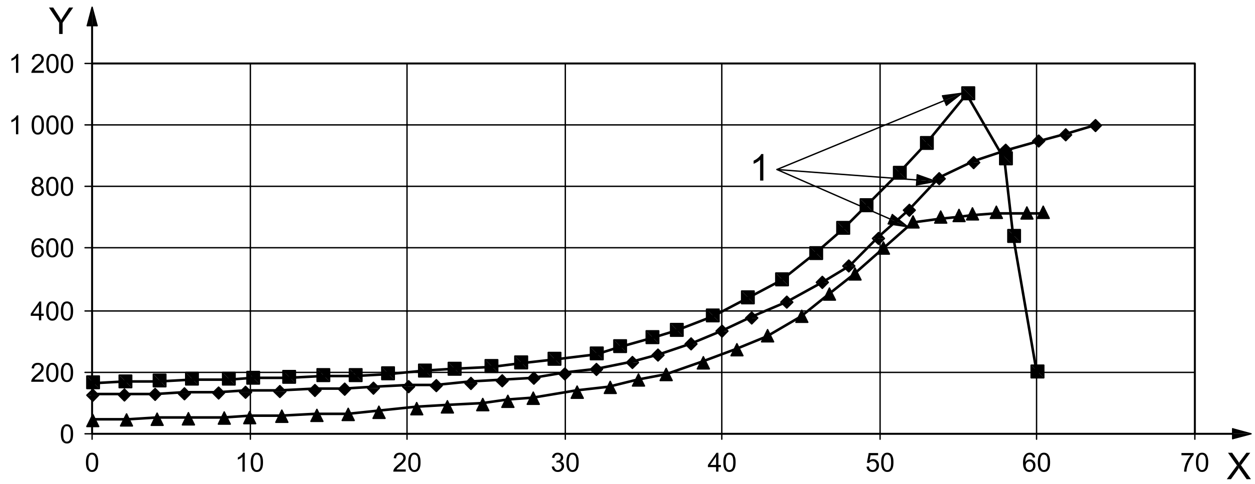
Used/unused: ....

Comment: ....

Minimum collapse/burst pressure rating: .... kPa

Annex C
(informative)

Examples of abrupt decrease in the slope of the differential pressure versus contaminant mass added curve



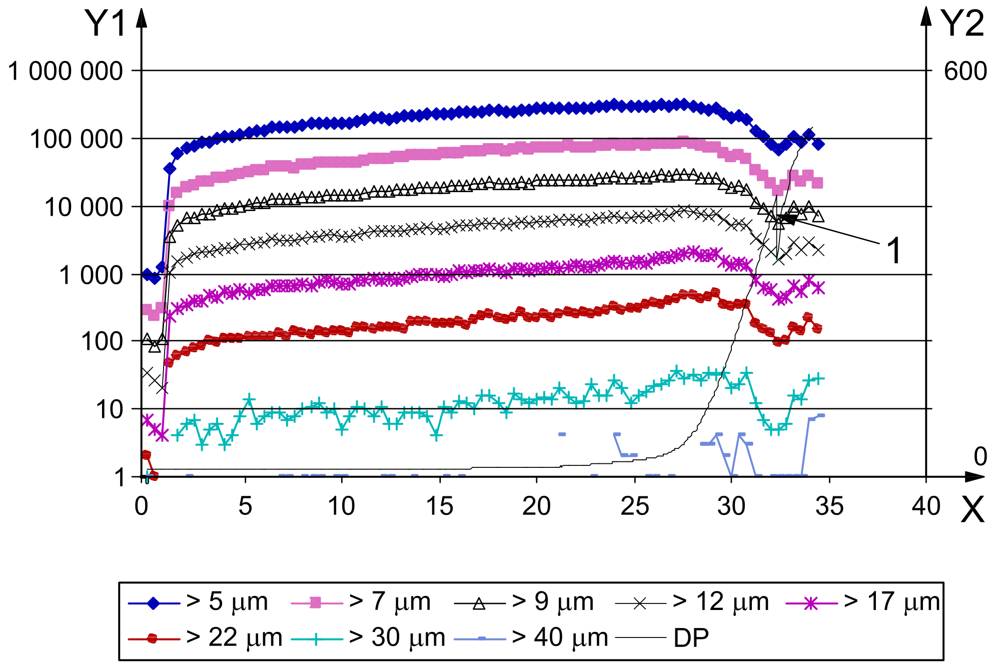
Key

X mass of ISO medium test dust added, expressed in grams

Y differential pressure, expressed in kilopascals

1 collapse points with an abrupt change in slope

Figure C.1 — Abrupt decrease in the slope of the curve of the differential pressure versus contaminant mass added — Example 1



Key

X mass of injected ISO medium test dust, expressed in grams

Y1 number of particles per 10 mL

Y2 differential pressure, expressed in kilopascals

1 collapse pressure of the inner tube

Figure C.2 — Abrupt decrease in the slope of the curve of the differential pressure versus contaminant mass added curve — Example 2

ICS 23.100.60

Price based on 9 pages