
**Agricultural irrigation equipment —
Filters for microirrigation —**

**Part 4:
Granulated media filters**

Matériel agricole d'irrigation — Filtres pour micro-irrigation —

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Published in Switzerland

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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).

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For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 23, *Tractors and machinery for agriculture and forestry*, Subcommittee SC 18, *Irrigation and drainage equipment and systems*.

A list of all parts in the ISO 9912 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Agricultural irrigation equipment — Filters for microirrigation —

Part 4: Granulated media filters

1 Scope

This document specifies construction requirements and test methods for pressurized granulated media filters, hereinafter referred to as media filters, intended for operation in agricultural irrigation systems.

It is applicable to both manual cleaning media filters and automatic self-cleaning media filters, used as single unit or in batteries (two or more units working in parallel).

This document covers the operation and performance of a media filter, together with all related valves, back flushing mechanism, underdrains, manifolds and other related accessories necessary for the operation of the filter.

This document is applicable to three configurations of a filter.

- a) An empty filter vessel (tank) housing.
- b) A filter vessel filled with media filter material(s), complete with valves, connections, air release and/or other accessories. This configuration, when connected to and controlled by a flushing control device, is a complete operating single filter unit, usually positioned as a part of a filtration station.
- c) A filtration station, called “filter battery”.

[Annex A](#) provides information on types of irrigation media filters.

[Annex B](#) provides information on granulated media.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 9644, *Agricultural irrigation equipment — Pressure losses in irrigation valves — Test method*

ISO 9912-1, *Agricultural irrigation equipment — Filters for micro-irrigation — Part 1: Terms, definitions and classification*

ISO 9912-2:2013, *Agricultural irrigation equipment — Filters for microirrigation — Part 2: Strainer-type filters and disc filters*

ISO 9912-3, *Agricultural irrigation equipment — Filters for microirrigation — Part 3: Automatic flushing strainer-type filters and disc filters*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 9912-1, ISO 9912-3 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

3.1 **granulated media filter** **media filter**

permeable granulated media, such as sand, gravel, crushed granite or synthetic material, with a specific gravity higher than water and used for filtration, provided the granules can be fluidized during back flushing

3.2 **clogged filter element**

filter element that has collected a quantity of residue such that it cannot maintain the highest flow rate recommended by the manufacturer without exceeding the *safe maximum pressure drop* (3.6)

3.3 **flush valve**

valve through which back flushing water is discharged from the filter

3.4 **nominal pressure**

p_{nom}

numerical designation equal to the maximum working pressure specified by the manufacturer at which a device will operate at a water temperature of $23^{\circ}\text{C} \pm 3^{\circ}\text{C}$

3.5 **clean pressure drop**

pressure drop in a clean filter measured with a flow of clean water

3.6 **safe maximum pressure drop**

maximum allowable difference between inlet and outlet pressures across a filter, when the filter element has become clogged to the extent of requiring cleaning or replacement, as specified by the filter manufacturer

3.7 **range of recommended flow rates**

q_{min} to q_{max}

range of flow rates declared by the manufacturer for proper operation of a filter

3.8 **nominal size**

conventional numerical designation, the same as the nominal diameter of the pipes to which the filter can be connected directly, indicating the size of the filter connections

4 Design and construction requirements

4.1 General

A complete media filter system includes the following connections:

- a) an inlet: the point of entry for unfiltered supply water;

- b) an outlet: the point of exit for filtered water going to the irrigation network;
- c) a back flush outlet: the point of exit for water and residue that are flushed out during the back flushing stage;
- d) a command power source: for the activation of an automatic back flushing operation, normally hydraulically-operated by filtered water (can also be pneumatically-operated or electrically-operated).

Components belonging to filters of the same nominal size, type and model, and produced by the same manufacturer, shall be interchangeable.

Filter parts that are in contact with water shall be made of non-toxic materials, and shall be resistant to, or protected against, degradation caused by existing working conditions and types of water used in agricultural irrigation. The filter housing shall be resistant to environmental conditions in the intended application.

Plastics parts of a filter that are exposed to ultraviolet radiation under normal working conditions in which the filter operates in the intended application shall include additives to improve their resistance to UV radiation. Plastics parts that enclose waterways shall be opaque or shall be provided with an opaque cover that blocks all light from reaching clear waterway enclosures.

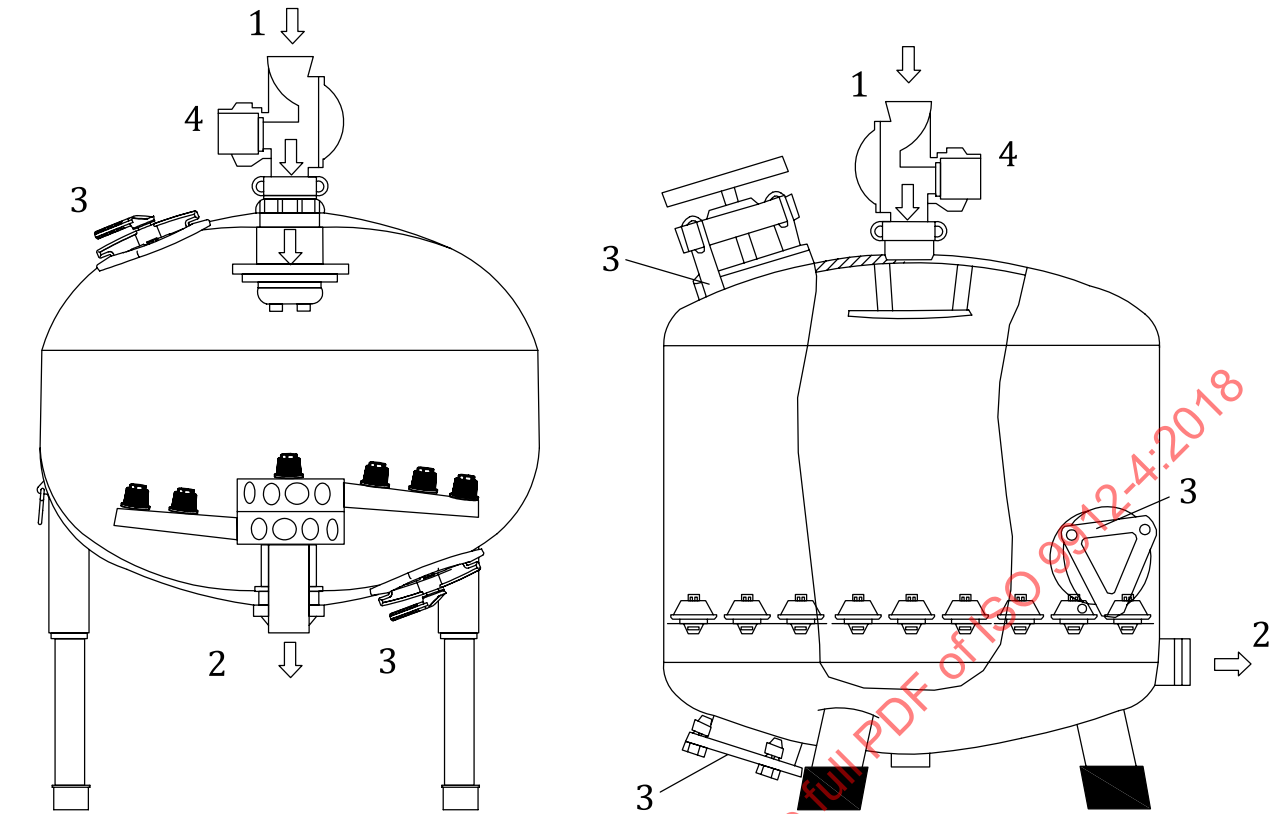
The construction of the filter shall facilitate its proper installation in its intended location and position.

The construction of the filter body shall permit dismantling for maintenance, according to manufacturer's instructions.

In most cases, a filtered flush stream is supplied by other filter units of the battery that are in the filtering stage. In case other options are used to supply flush water, the supplier shall guarantee that it is in accordance with this document.

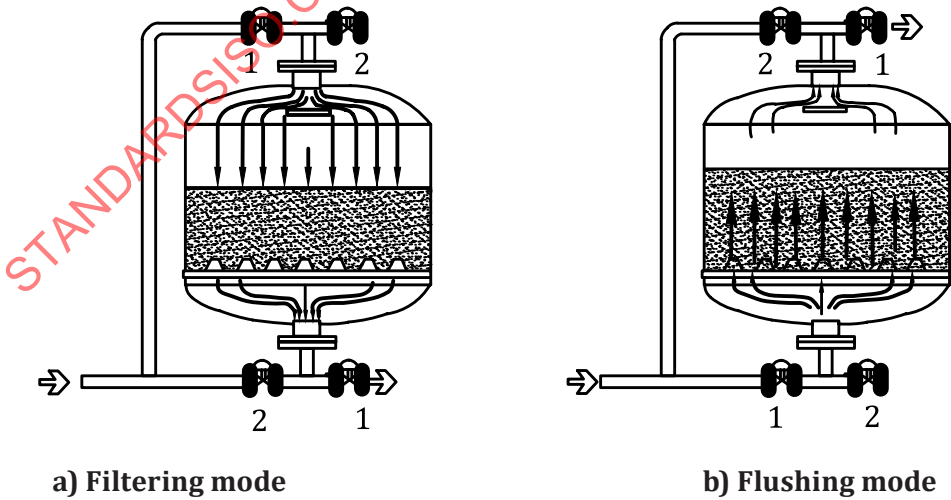
The back flushing flow rate shall be high enough to vigorously fluidize and agitate the entire media, yet low enough so that only residue is washed from the tank and not the filter media itself.

Typical media filter constructions are shown in [Figure 1](#). Two operational modes of a media filter are shown in [Figure 2](#).



- Key**
- 1 inlet
 - 2 outlet
 - 3 service port
 - 4 backflush valve

Figure 1 — Typical media filter construction



- Key**
- 1 opened
 - 2 closed

Figure 2 — Two operational modes of a media filter

4.2 Inlet and expansion space chamber

The inlet and expansion space chamber shall be able to accommodate expansion of the media during back flushing. The expansion volume shall be at least one third of the media volume.

The chamber shall have a cover to enable media filling and visual inspection. Filter covers operating under pressure shall be supplied with a safety mechanism to protect the operator in case of a catastrophic failure. The filter vessel shall provide for the relief of internal pressure before opening any internal access ports. All access ports shall be secured to the filter vessel with suitable fasteners to prevent harm when attempting to loosen or remove covers or lids.

A hydraulic inlet distributor that evenly distributes incoming flow across media surface is recommended.

4.3 Media chamber

The media chamber is the main part of the filter.

Total volume, surface area and the depth of the filtering layer shall be clearly indicated on the filter body. If a rough media support layer is used, its dimensions shall be deducted from the active media parameters.

If the filter tank shape is not a cylinder, the surface area as a function of media level shall be indicated in the manufacturer's documentation.

Both ends of the filter media chamber shall have large, accessible service ports: at the top for checking and for media filling, and at the bottom for media replacement and underdrain service.

Parameters pertaining to specific granular media shall be supplied by the manufacturer.

4.4 Collection (underdrain) and back flushing unit

This component collects the filtered water, while not allowing media leakage. In the back flushing stage, it distributes reverse water flow used for back flushing.

There are several possible configurations for this unit:

- a) a diffuser system assembled on a collection piping ("spider web");
- b) a diffuser system mounted on top of a plate, which separates the filtering chamber from the collection chamber ("underdrain plate");
- c) other variations of patterns.

Diffuser placement shall ensure even distribution of back flushing water over the whole granular media surface area.

The filter's underdrain shall be designed to retain the media sand and resist clogging by fine particle matter.

The size of the underdrain slot shall be no more than half the size of the smallest media grain.

4.5 Prefiltration element

- a) The design of a prefiltration element, its filtering area, the size of water passages and their shape should be appropriate for the water quality for which the filter is intended.

NOTE 1 The prefiltration element is an optional component.

- b) When a prefiltration element exists, the maximum pressure drop across it shall be less than the safe maximum pressure drop of the prefiltration element.

In case of no prefiltration pressure drop indication, the total pressure drop across it and the filter assembly shall be less than the safe maximum pressure drop.

- c) The prefiltration element shall be an integral part of the filter while being tested. (This element is not intended to be tested separately.)

NOTE 2 The prefiltration element is not automatically flushed.

4.6 Back flushing control

4.6.1 Mandatory requirements

The construction of an automatic self-cleaning filter shall conform to the following requirements.

- a) The flushing control system shall either be part of the filter assembly, supplied by the manufacturer together with the filter, or shall be a separate part produced by the filter manufacturer and supplied according to special request of the customer. Alternatively, the flushing control system may be manufactured by a third party, provided that it is approved by the filter manufacturer and is included in the information supplied by the manufacturer (see [Clause 9](#)).
- b) The construction of the filter shall allow manual actuation of the flushing in the event of failure of the automatic flushing control mechanism.
- c) The flushing control mechanism shall allow manual flushing at any time, independent of the conditions that apply to automatic flushing.
- d) The coordination of the flushing operation and the opening of the flushing valve shall prevent water flowing out of this valve, unless the filter is being cleaned. During flushing, it shall be open for at least one full flushing operation.
- e) The initiation and termination of flushing shall be activated either by pressure differential, by duration of filtration, by volume of water filtered, by another physical quantity, or by a combination of these.

4.6.2 Optional features

In addition, the following construction features are commonly used.

- a) The filter may be fitted with a device that enables adjustment of the pre-set value of the flushing control mechanism for initiation of the flushing cycle and/or for controlling the duration and termination of the flushing cycle.
- b) The filter may be equipped with a protective mechanism that prevents repeated flushings.
- c) All hydraulically operated accessories of the filter should be operated using filtered water, with the exception of the inlet pressure signal which may come from non-filtered water.

5 Resistance of the filter to internal hydrostatic pressure

5.1 General

The tests shall be performed on a filter assembled for normal operation according to manufacturer's instructions. Internal parts and granular media may be excluded. All tests shall be performed with water at a temperature between 10 °C and 30 °C, unless otherwise indicated in the specific test description. The instruments used for measuring the various parameters shall permit measurement to an accuracy of ± 1 % of the actual values.

5.2 Preparation

Close the filter housing service ports according to the manufacturer's instructions, including the required closure force or moment. If a specific tool is required, it shall be supplied by the manufacturer. Measure the force or moment required for this operation.

Before conducting the test on filters equipped with a drain valve, open and close the valve 100 times while applying a water pressure at the valve inlet equal to the nominal operating pressure multiplied by 0,75.

Close the filter outlet by suitable means. Fill the filter with water and check that no air remains trapped in the system and that the water reaches all places that may be under pressure during filter operation. Apply the hydraulic pressure required for the test at the filter inlet.

5.3 Static pressure test

Raise the pressure gradually to the nominal pressure multiplied by 1,5, then close the valve to isolate from the pump and maintain this pressure for at least 5 min.

If the seal of the filter housing service ports swells or is dislodged, it may be returned to its location and the closing torque increased to achieve a positive seal. Following that, reapply the required pressure for an additional 15 min and recheck the seal's condition.

The filter shall withstand the test pressure without suffering any damage or any visible permanent deformation. No signs of leakage shall appear through the filter housing, the filter service ports seals or the drain valve.

5.4 Cyclic pressure test

5.4.1 Position the filter in a test bench as shown in [Figure 3](#). Fill the test system with water and raise the pressure to 1 bar.

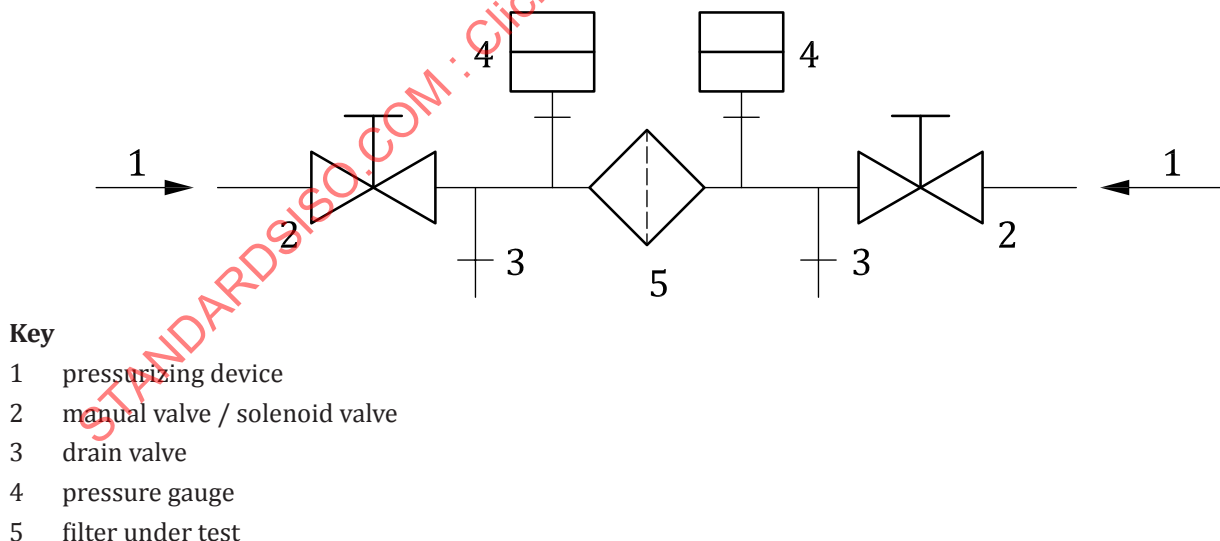
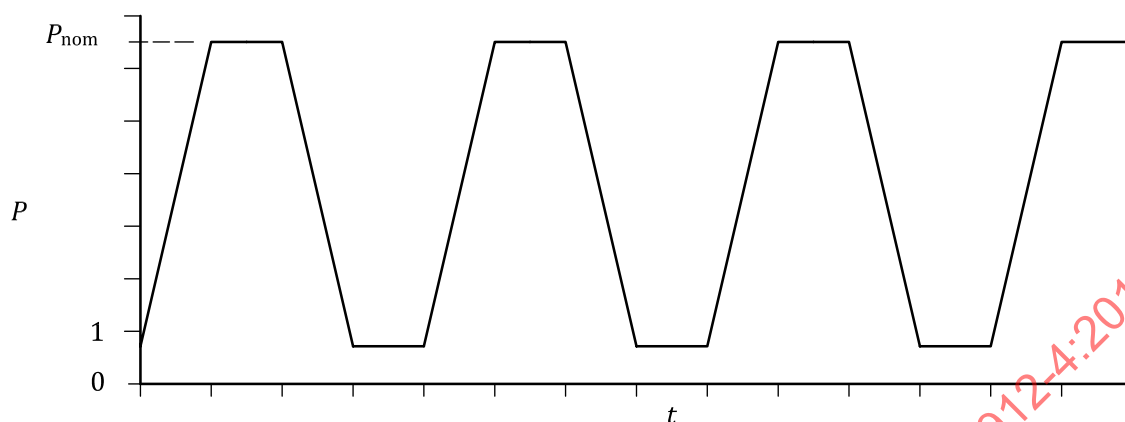


Figure 3 — Cyclic pressure test bench

5.4.2 Apply a cyclic pressure simultaneously at both the inlet and the outlet of the filter, increasing gradually from 1 bar to the nominal pressure (p_{nom}), maintaining this pressure, then decreasing gradually to 1 bar, as shown in [Figure 4](#).



Key

t time, in seconds
 p pressure, in bars

Figure 4 — Cyclic pressure sequence

The duration of pressure increase, pressure decrease and constant pressure periods shall be according to [Table 1](#).

Table 1 — Duration of cyclic pressure steps

Filter volume l (litre)	Duration of pressure increase/decrease s	Duration of constant pressure s
0 to 60	4 ± 1	4 ± 1
61 to 200	8 ± 2	8 ± 2
201 to 600	15 ± 3	15 ± 3
above 600	25 ± 5	25 ± 5

5.4.3 Continue applying the same cyclic pressure pattern for 20 000 cycles.

5.4.4 Then, continue applying a similar cyclic pressure pattern for 2 000 cycles, with pressure cycling between 1 bar and $1,5 \times p_{nom}$.

5.4.5 Increase the pressure to $1,5 \times p_{nom}$ for filters with a metallic housing, or to $3 \times p_{nom}$ for filters with a plastic (in whole or in part) housing, and maintain it for an additional period of 30 min.

5.4.6 The filter conforms to the test requirements if there is no evidence of leakage from the filter shell, and no fracture or other failure occurs during the test. Packing leakage shall not be a cause for rejection.

5.5 Collection (underdrain) and back flushing unit resistance to buckling or tearing

Use a thin film of impermeable plastics, for example, polyethylene, PVC or cello tape, to seal all the filter diffusers ("mushrooms") against the flow of water.

The filter diffusers may be sealed in any other manner, provided the seal does not increase or decrease the resistance of the filter unit to buckling or tearing.

Keeping the filter outlet open, apply a hydraulic pressure at the inlet of the filter and raise it gradually up to the safe maximum pressure drop. Maintain this pressure for 15 min.

The leakage allowed at the filter outlet shall not exceed 0,1 % of the maximum recommended flow rate for the filter under test. This leakage shall remain steady or decrease during the test.

Examine the filter visually. The filter element shall show no signs of permanent deformation, cracks or tears.

6 Clean pressure drop test

6.1 General

Perform the test in accordance with the method described in ISO 9644, using the following parameters.

6.2 Flow rates and test sequence

The test shall be conducted at approximately the following flow rates:

- a) $q_{\min}$;
- b) $0,4 \times q_{\max}$;
- c) $0,7 \times q_{\max}$;
- d) $q_{\max}$;
- e) $1,2 \times q_{\max}$.

The test shall proceed from the lowest to the highest flow rate.

6.3 Filter media

The filter media used for the clean pressure drop test shall be recommended by the manufacturer. It shall be of the most commonly used grades, not extremely fine or extremely coarse. The tests shall be conducted with newly installed back flushed media.

6.4 Prescreening

Prescreen the water used for testing pressure loss in clean filter media by passing the water through a filter element with an aperture size at least 50 % smaller than the common declared filtration capability of the filter being tested. This prescreening will avoid or reduce the need to back flush the filter during a single complete flow rate test run.

6.5 Inlet and outlet pressures

Inlet pressures shall be maintained at the manufacturer's maximum recommended operating levels. Inlet and outlet pressures, or inlet and differential pressures, shall be reported for each flow rate, once equilibrium conditions have been established.

Back flush, if necessary, to maintain the manufacturer's recommended post back-flushing pressure differential.

6.6 Test duration

The duration of testing each pressure/flow rate combination depends on the time required for the entire system to reach conditions of hydraulic equilibrium, as determined by monitoring pressure and flow rate fluctuations.

6.7 Report

All flow rates tested shall be reported. The specific criteria used for each test period and general test conditions shall be reported.

The measured pressure drop shall not exceed the pressure drop declared by the manufacturer by more than 10 %.

7 Back flushing tests

7.1 Back flushing parameters

7.1.1 Prior to conducting this test, flush the media in accordance with the media manufacturer's instructions for normal field operating conditions.

7.1.2 Connect the filter to a test assembly simulating field installation as described in the manufacturer's instructions. The test assembly shall be capable of supplying at least twice the maximum flushing volume and the maximum flow rate, at the nominal pressure.

7.1.3 Attach a collection vessel to the flushing opening of the filter (flush collecting manifold) for collecting the flush water. Set the pressure at the filter inlet to the minimum working pressure and perform the flushing cycle manually.

7.1.4 Measure:

- a) the time from the moment the flush valve begins to open to the time it shuts;
- b) the volume of flushing water.

7.1.5 With reference to the manufacturer's instructions for back flushing, repeat the test three times for each flow rate at the recommended minimum back flushing flow rate and three times at the recommended maximum back flushing flow rate.

7.1.6 The following requirements shall be met:

- a) the flushing mechanism shall operate satisfactorily;
- b) the volume of water measured in each of the tests shall not exceed the volume of flushing water declared by the manufacturer by more than 7 %;
- c) the average duration of flushing of all six tests shall not deviate by more than 15 % from the flushing duration declared by the manufacturer.

7.2 Media escape test

Install a large volume fine screen at the back flushing outlet port.

Operate the flushing cycle six times at the maximum recommended flushing flow rate.

Collect all media that have escaped. Dry and weigh them separately for each cycle.

The total escaping media (combined from all six cycles) shall not exceed 0,015 % by mass of the total media in the filter. In the six flushing cycles, there should be a rapid decline in the amount of media escaping in each consecutive cycle. The separate weighing should show such a decline.

Upon completion of each set of back flushing tests, inspect the granular media visually for any appearance of depressions, uneven upper surface media, channelling, tunnelling, or other factors that

may reduce filtration effectiveness. Record and report the existence, nature, depth and size of these occurrences.

8 Automatic back flushing and controller

8.1 Back flushing initiation

Initiation of the back flushing operation of the filter system shall be in accordance with the manufacturer's criteria, by one of the following techniques:

- a) a specified pressure drop across the filter system;
- b) a specified time period;
- c) a combination of time period and pressure drop;
- d) a specified volume of filtered water;
- e) another physical quantity.

8.2 Flushing control mechanism test

8.2.1 Mechanism activated by pressure drop

Disconnect the "low" pressure connection from the differential pressure sensor and connect it to an external pressure source. Leave the "high" pressure connection as connected for regular filter operation.

Apply a pressure equal to the minimum filtering pressure at the filter inlet and at the external pressure source. Gradually reduce the pressure at the external pressure source until the flushing operation is initiated.

Repeat the test once with a filter inlet pressure at midrange between the minimum filtering pressure and the nominal pressure, and once more with a filter inlet pressure equal to the nominal pressure.

The pressure difference (the filter inlet pressure minus the external source pressure) that causes initiation of flushing shall not deviate by more than 10 % from the pressure drop declared by the manufacturer.

8.2.2 Mechanism activated by duration of operation

Perform this test three times, each time presetting the flushing control mechanism to a different time interval (short, long and intermediate) within the range of adjustment declared by the manufacturer.

Operate the filter with an inlet pressure equal to the minimum filtering pressure. Measure the time interval between one activation and the next one.

Repeat the test with a filter inlet pressure equal to the nominal pressure.

The time interval between the two activations shall not deviate by more than 5 % from the preset time interval.

8.2.3 Mechanism activated by volume of filtered water

Perform the test twice, each time presetting the flushing control mechanism to a different volume of water within the range specified by the manufacturer. Select one volume setting from the lower 20 % of the range and the second setting from the upper 20 % of the range.

Operate the filter and measure the volume of water flowing through the filter up to activation of the automatic flushing control mechanism.

The measured volume of water flowing through the filter shall not deviate by more than 10 % from the preset volume of water.

8.2.4 Mechanism activated by another physical quantity

Connect the filter to a water source and make all the adjustments necessary in accordance with the manufacturer's instructions.

Maintain the pressure at the inlet to the filter at the minimum filtering pressure.

If the flushing control mechanism is adjustable, conduct the test three times, with the flushing control mechanism preset differently each time, to the lowest, highest and mid-range setting, respectively. Otherwise, conduct the test only once.

Operate the filter according to the manufacturer's instructions until the flushing cycle has been completed.

Measure the value of the activating physical quantity at the initiation of each flushing cycle.

Repeat the entire process with the pressure at the inlet of the filter readjusted to the nominal pressure.

The following requirements shall apply:

- a) the flushing cycle shall be initiated and shall proceed as prescribed by the manufacturer;
- b) the value of the activating physical quantity at the initiation of any flushing cycle shall not deviate by more than 10 % from the preset value for an adjustable mechanism, or by more than 10 % from the value declared by the manufacturer for a non-adjustable mechanism.

8.3 Operation of the protective device

This test is applicable to filters equipped with a protective mechanism to prevent repeated flushing.

Operate the filter at an inlet pressure equal to the minimum filtering pressure. Perform three consecutive flushings manually.

The filter shall flush satisfactorily.

Continue operating the flushing mechanism manually several times until the protective mechanism stops the flushing cycle, or create by artificial means the conditions declared by the manufacturer that should activate the protective mechanism.

Depending on the type of control mechanism, the number of flushings or the time that elapsed until activation of the protective mechanism, shall not deviate by more than 10 % from the manufacturer's declaration.

9 Information to be supplied by the manufacturer

9.1 General

In addition to the information specified in ISO 9912-2:2013, Clause 7, the manufacturer shall supply the information in [9.2](#) and [9.3](#), as applicable.

9.2 Filter data

Filter data information:

- a) minimum and maximum working pressures;
- b) minimum pressures required for
 - 1) filtering operation,
 - 2) flushing operation, and
 - 3) operation of the control system;
- c) pressure drop required to initiate flushing;
- d) safe maximum pressure drop;
- e) minimum flow rate ($q_{\min}$);
- f) maximum flow rate ($q_{\max}$);
- g) duration of flushing;
- h) volume of flush water within the range of the working pressures;
- i) range of possible adjustments for flushing control according to time, volume, etc.;
- j) in filters equipped with a protective mechanism: number of repeat flushings or the length of time until flushing stops;
- k) recommended diameter and maximum length of pipe for disposal of flush water to prevent back pressure;
- l) drawings describing the filter and the filter battery, their parts and the method of assembly;
- m) chart of head-loss versus flow rate, for a media specified by the manufacturer;
- n) recommended filter media for the clean pressure drop test;
- o) chemical and corrosion resistance table (oxidants used for media bleaching, and chemicals commonly used in agriculture, should be at the top of this table);
- p) maintenance instructions;
- q) total volume, surface area and depth of the sand media.

9.3 Back flushing controller

Back flushing controller information:

- a) power supply and driving source;
- b) instructions regarding prefiltering (if applicable);
- c) complete operating manual;
- d) troubleshooting;
- e) maintenance instructions;
- f) list of spare parts for the controller system.