BS EN 16713-1:2016

BSI Standards Publication

Domestic swimming pools — Water systems

Part 1: Filtration systems — Requirements and test methods

...making excellence a habit.™

National foreword

This British Standard is the UK implementation of EN 16713-1:2016.

The UK participation in its preparation was entrusted to Technical Committee SW/136/8, Swimming pools and aquatic equipment.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Published by BSI Standards Limited 2016

ISBN 978 0 580 85291 6

ICS 97.220.10

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 29 February 2016.

Amendments/corrigenda issued since publication

Date	Text affected

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 16713-1

February 2016

ICS 97.220.10

English Version

Domestic swimming pools - Water systems - Part 1: Filtration systems - Requirements and test methods

Piscines privées à usage familial - Systèmes de distribution d'eau - Partie 1: Systèmes de filtration - Exigences et méthodes d'essai

Schwimmbäder für private Nutzung - Wassersysteme - Teil 1: Filtrationssysteme - Anforderungen und Prüfverfahren

This European Standard was approved by CEN on 5 December 2015.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

Ref. No. EN 16713-1:2016 E

Contents

Page

European foreword ... 4
Introduction ... 5
1 Scope ... 6
2 Normative references ... 6
3 Terms and definitions ... 7
4 Requirements ... 12
4.1 General ... 12
4.2 Maximum filter flow rate ... 12
4.3 Filter media ... 12
4.3.1 General ... 12
4.3.2 Granular media ... 12
4.3.3 Sand filter media ... 13
4.3.4 Alternatives to sand media ... 13
4.4 Maximum operating pressure (MOP) ... 13
4.5 Turbidity reduction efficiency ... 13
4.6 Retention capacity ... 13
4.7 Backwashing/Replacement/Cleaning Criteria ... 13
4.7.1 General ... 13
4.7.2 Specific backwash conditions ... 14
4.8 Construction requirements ... 15
5 Pressure resistance (pressure filter) ... 15
5.1 General ... 15
5.2 Static pressure resistance test ... 15
5.2.1 Principle ... 15
5.2.2 Test pressure ... 15
5.2.3 Equipment and reagents ... 16
5.2.4 Procedure ... 16
5.2.5 Acceptance criteria ... 17
5.3 Cyclic pressure variation resistance test ... 17
5.3.1 Principle ... 17
5.3.2 Equipment and products ... 17
5.3.3 Operating protocol ... 19
5.3.4 Acceptance criteria ... 20
5.3.5 Expression and presentation of results ... 20
5.4 Determination of the burst pressure ... 20
5.4.1 Procedure ... 20
5.4.2 Acceptance criteria ... 21
5.4.3 Test report ... 21
6 Pressure resistance (negative pressure filter) ... 22
6.1 General ... 22
6.2 Test pressure ... 22
6.3 Static negative pressure resistance test ... 22
6.3.1 Principle ... 22
6.3.2 Equipment and reagents ... 22

6.3.3 Procedure ... 23
6.3.4 Acceptance criteria ... 23
6.4 Cyclic negative pressure variation resistance test ... 24
6.4.1 Principle ... 24
6.4.2 Equipment and products ... 24
6.4.3 Operating protocol ... 25
6.4.4 Acceptance criteria ... 26
6.4.5 Expression and presentation of results ... 26
6.5 Determination of the negative collapsing pressure ... 26
6.5.1 Procedure ... 26
6.5.2 Acceptance criteria ... 27
6.5.3 Test report ... 27

7 Test methods for filtration efficiency ... 28
7.1 Principle ... 28
7.2 Turbidity reduction and contaminant retained mass ... 28
7.2.1 Purpose ... 28
7.2.2 Principle ... 28
7.2.3 Equipment and products ... 28
7.2.4 Turbidity reduction test ... 30
7.2.5 Simplified 20 cycles retention test (dp20) ... 32
7.2.6 Expression and presentation of results ... 35
7.2.7 Test report ... 35
7.3 Filtration efficiency and retention capacity ... 36
7.3.1 Principle ... 36
7.3.2 Equipment and products ... 37
7.3.3 Operating protocol ... 40
7.3.4 Calculations ... 43
7.3.5 Expression and presentation of results ... 44

8 Instructions and operation ... 45
8.1 General principles ... 45
8.2 Point-of-purchase information ... 46
8.3 User's manual ... 47
8.3.1 Installation ... 47
8.3.2 Operation ... 47
8.4 Maintenance advice ... 48

Annex A (informative) Harmonized pump curves for the filtration efficiency and retention capacity tests ... 49

Annex B (informative) Example of test report verifying the resistance to fatigue caused by cyclic pressure or negative pressure variations ... 51

Annex C (informative) Environmental aspects ... 53

Bibliography ... 56

European foreword

This document (EN 16713-1:2016) has been prepared by Technical Committee CEN/TC 402 “Domestic Pools and Spas”, the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by August 2016, and conflicting national standards shall be withdrawn at the latest by August 2016.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

EN 16713, *Domestic swimming pools — Water systems*, currently comprises:

— *Part 1: Filtration systems— Requirements and test methods*;

— *Part 2: Circulation systems— Requirements and test methods*;

— *Part 3: Water treatment— Requirements*.

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

The filtration system in any swimming pool is there to remove the suspended matter from the pool water. Filtration is achieved by passing the water through a suitable medium contained in a filter body.

It is generally accepted that there are four types of filters associated with swimming pools:

a) pre-coat filtration/diatomaceous earth (DE);

b) disposable cartridge or filter bag;

c) graded aggregate (single/multi-layer-filter);

d) other filters (e.g. membrane systems).

1 Scope

This European Standard specifies filtration requirements and test methods of filter elements or media, filtration units or systems designed to be used in domestic swimming pools.

This standard applies to swimming pools as defined in EN 16582-1 and will be read in conjunction with it.

This standard does not apply to:

— pools for public use covered by EN 15288-1;

— spas for domestic or public use;

— paddling pools according to EN 71-8;

— pre filtration;

— natural and nature like pools.

NOTE For circulation systems see EN 16713–2 and for treatment systems EN 16713–3.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 837-1, *Pressure gauges — Part 1: Bourdon tube pressure gauges — Dimensions, metrology, requirements and testing*

EN 872, *Water quality — Determination of suspended solids — Method by filtration through glass fibre filters*

EN 12902, *Products used for treatment of water intended for human consumption — Inorganic supporting and filtering materials — Methods of test*

EN ISO 7010:2012, *Graphical symbols — Safety colours and safety signs — Registered safety signs (ISO 7010:2011)*

HD 60364-7-702, *Low-voltage electrical installations — Part 7-702: Requirements for special installations or locations — Swimming pools and fountains (IEC 60364-7-702)*

ISO 3864-2, *Graphical symbols — Safety colours and safety signs — Part 2: Design principles for product safety labels*

ISO 12103-1, *Road vehicles — Test dust for filter evaluation — Part 1: Arizona test dust*

ISO 21501-3, *Determination of particle size distribution — Single particle light interaction methods — Part 3: Light extinction liquid-borne particle counter*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
backwash
method of cleaning consisting of a flow of water through filter element(s) or media in a reverse direction to dislodge accumulated dirt and/or filter aid and remove them from the filter body

3.2
bulk density
ρ_B
mass of many particles of a material divided by the total volume they occupy; the total volume includes particle volume, inter-particle void volume and particle internal pore volume

Note 1 to entry: Bulk density in kg/m^3:

$$\rho_B = \frac{\text{mass}}{V_{\text{solid}} + V_{\text{pores}} + V_{\text{void}}} \quad (1)$$

3.3
cleaning
physical removal of soiling materials

3.4
cleaning differential pressure
maximum differential pressure allowed at the terminals of the filter element or the filter to guarantee its efficiency and from which the filter media should be cleaned or replaced

Note 1 to entry: It often corresponds to the differential pressure that defines the retention capacity of the filter element or filter.

3.5
filtrate
treated water after the filtration process

3.6
differential pressure
difference between the upstream and the downstream pressure of the filter

3.7
effective size d_x
size of the sieve in mm through which approximately x % of the total grains by weight are smaller

Note 1 to entry: d_{10} for the smaller size and d_{90} for the bigger size are generally used in the pool business.

Note 2 to entry: Effective size at x % (d_x).

3.8
filter
element made up of the filter body and the filter medium/media or filter element(s)

3.9
filter body
container enclosing the filter medium or filter element(s), and providing inlets and outlets for pool water to circulate through and connecting devices

3.10
filter element
interchangeable element comprising the filter medium and the end devices which force water to go through the filter medium by watertight contact with the filter body

EXAMPLE Filter cartridge, filter sock, filter pocket.

3.11
filter medium
natural or synthetic water-permeable material that retains the particles present in the water

EXAMPLE Sand, diatomaceous earth, zeolite, anthracite, folded nonwoven, agglomerated fibres.

Note 1 to entry: Some filter media can also have a chemical action.

3.12
filtration efficiency
ratio, multiplied by 100, of the number of particles with a dimension greater than or equal to a given dimension retained by the filter to the number of particles of the same dimension present at the same instant upstream of the filter:

$$Ed = \frac{Nd_{\text{e}} - Nd_{\text{s}}}{Nd_{\text{e}}} \cdot 100 \qquad (2)$$

where

Ed	is the filtration efficiency, expressed in percentage (%);
$Nd_{\text{e}} - Nd_{\text{s}}$	is the number of particles with a size greater than or equal to a given size (d in µm) retained by the filter at the instant t;
Nd_{e}	is the number of particles with a size greater than or equal to a given size (d in µm) present at the instant t upstream of the filter;
Nd_{s}	is the number of particles with a size greater than or equal to a given size (d in µm) present at the instant t downstream of the filter.

3.13
filtration rating
S
size of standardised grade A4 dust (ISO CTD) according to ISO 12103-1 for which the average filtration efficiency measured according to this standard is greater than 80 %

Note 1 to entry: Filtration rating in µm.

3.14
filtration system
all of the equipment suitable for the volume of water to be filtered, generally consisting of a filtration unit, a return/suction system, a skimmer and, if necessary, hydraulic connection

3.15
nominal flow rate
manufacturer's specified water flow rate with a clean filter for a given component or a combination of components (i.e. filter, filtration unit, filtration system)

Note 1 to entry: Nominal flow rate in m^3/h.

3.16
filtration unit
assembly made up of a pump, generally centrifugal, a filter body and one or more filter elements or a mass of granular filtering material which retains the suspended solids from the swimming pool water circulating through it

Note 1 to entry: The pump may be placed before or after the filter.

Note 2 to entry: The filter may be closed or open, out of the water or submerged.

3.17
granular media filter
filter whose media consists of separated solid material, forming a porous layer, used for the filtration of liquids

3.18
hydraulic connections
couplings, pipes and watertight equipment required for operating water circulation systems

EXAMPLE Hydraulic connection between the different component of the filtration unit or between the filtration unit and the basin.

3.19
limit cleaning value
minimum or maximum value of a specified operating parameter of the filter to ensure filtered water quality and impose the cleaning or replacement of the filter element or medium

Note 1 to entry: This limit cleaning value may be defined according to:

— the flow rate through the filter (minimum value), or

— the filter head loss (maximum value), or

— the increase of the pressure upstream the filter (maximum value);

— time (e.g. weekly).

3.20
maximum operating negative pressure
MONP
reduction of the nominal pressure by the clogging - induced additional pressure multiplied by a safety factor of 1,3

Note 1 to entry: The filter element cleaning and/or replacement criteria, and not the mechanical strength of the filter body, define the maximum operating negative pressure allowed.

Note 2 to entry: The additional pressure is generally measured downstream of the filter medium and can be caused by building up debris on the filter medium.

Note 3 to entry: MONP in kPa (bar).

3.21
maximum operating pressure
MOP
sum of the nominal pressure and the clogging - induced additional pressure multiplied by a safety factor of 1,3

Note 1 to entry: The filter element cleaning and/or replacement criteria, and not the mechanical strength of the filter body, define the maximum allowable pressure.

Note 2 to entry: The additional pressure is generally measured upstream of the filter medium and can be caused by building up debris on the filter medium.

Note 3 to entry: MOP in kPa (bar).

3.22
net differential pressure
difference between initial differential pressure at beginning of the test and the final differential pressure at the end of the test

[SOURCE: EN 13443-2:2005+A1:2007, 3.24, modified — the definition was altered and the symbol originally mentioned is not reproduced here.]

3.23
nominal pressure,
for closed systems only, manufacturer's specified upstream/downstream pressure of the clean filter at its nominal flow rate

Note 1 to entry: Nominal pressure in kPa (bar).

3.24
retained mass
mass of standardized grade A4 dust (ISO CTD) according to ISO 12103-1 retained by the filter upon completion of the retention capacity test

Note 1 to entry: Retained mass in g.

3.25
retention capacity
Cr
mass of standardized grade A4 dust (ISO CTD) according to ISO 12103-1 effectively retained by the filter at the limit cleaning value calculated by subtraction of the mass of contaminant in the filtrate from the injected mass

Note 1 to entry: Retention capacity is given in g.

3.26
return system
all of the equipment specifically designed to reinject the filtered water into the pool from the filtration unit

3.27
suction system
all of the equipment ensuring the water flow output from the pool into the filtration unit through one (or more) water recovery part(s)

3.28
system volume
total amount of water in the test circuit including the test filter unit

Note 1 to entry: Therefore the volume of the reservoir and the volume of the wet media and interstitial and wetting volume should be considered.

3.29
recirculation cycle
complete turnover of the system volume through the test circuit

3.30
turbidity reduction efficiency
TBR
ratio, multiplied by 100, between the decrease of the upstream turbidity after 20 cycles and the initial upstream turbidity (excluding the raw water turbidity)

$$TBR = \frac{(TB_{\mathrm{us,0}} - TB_{\mathrm{rw}}) - (TB_{\mathrm{us,20}} - TB_{\mathrm{rw}})}{(TB_{\mathrm{us,0}} - TB_{\mathrm{rw}})} \cdot 100 \qquad (3)$$

where

TBR	is the turbidity reduction efficiency, expressed in percentage in %;
$TB_{\mathrm{us,20}}$	is the upstream turbidity measured after 20 recirculation cycles;
$TB_{\mathrm{us,0}}$	is the upstream initial turbidity measured at the start of the test procedure;
TB_{rw}	is the raw water turbidity before addition of the standard contaminant (ISO CTD).

3.31
uniformity coefficient
C_u
ratio of the sieve size at which 60 % of the grains by weight pass through (D_{60}) over the sieve size at which 10 % of the grains by weight pass through (D_{10})

$$C_u = D_{60} / D_{10} \qquad (4)$$

where

D_{60}	is sieve size at 60 % passing;
D_{10}	is sieve size at 10 % passing.

Note 1 to entry: See EN 12901.

4 Requirements

4.1 General

All of the tests carried out and claimed performances are for new products.

If air is trapped in the filter body, then it needs to be evacuated.

Assembled in accordance with the assembly and commissioning manual, the electrical installation of any material related to the pool and its surrounding shall comply with the requirements of HD 60364-7-702 or valid national/regional requirements.

4.2 Maximum filter flow rate

The filtration flow rate shall be adapted to the nature and surface area of the filter medium used in the filter.

The velocity at which the water to be filtered passes through the new filter medium shall be adapted to the type of medium used.

The following list of common, but not exhaustive maximum permissible velocities is given as the flow rate per unit surface area of the filter medium:

a) granular media filter: low rate ≤ 10 $(m^3/h)/m^2$;

b) granular media filter: medium rate > 10 $(m^3/h)/m^2$ to ≤ 30 $(m^3/h)/m^2$;

c) granular media filter: high rate > 30 $(m^3/h)/m^2$ to ≤ 50 $(m^3/h)/m^2$;

d) diatomaceous earth filter ≤ 5 $(m^3/h)/m^2$;

e) synthetic cartridge filter ≤ 3 $(m^3/h)/m^2$;

f) paper cartridge filter ≤ 2 $(m^3/h)/m^2$.

Regardless of any adopted flow rates, all filters shall demonstrate their efficiency according to Clause 7.

NOTE For the granular media filter, the filtration surface area to be taken into account is that of the inside horizontal cross section of the filter vessel, generally taken at 2/3rd of its height. For the other types of filter, the total functional developed surface area of the support (unfolded) is taken into account.

4.3 Filter media

4.3.1 General

If the filter medium being used is covered by an existing European standard this standard shall be applied.

NOTE See Bibliography.

4.3.2 Granular media

In general, dealing with granular filter media, the type of filter media and height of filter media within the filter are some of the main aspects, which are expected to be supplied by the manufacturer.

The specification of the media shall include:

— chemical composition;

— density of a material (in kg/m^3) (also called specific gravity);

— bulk density (uncompacted and/or packed) (in kg/m^3);

— effective size (in mm);

— uniformity coefficient C_u, which represents the degree of uniformity in a granular material;

— height of filter media and/or its mass to be used because it is directly related to the performance of the unit.

In case of multilayer filter, the specification of the media for each layer as well as the height or mass of each one shall be specified.

4.3.3 Sand filter media

Sand filter media shall be silica and free from carbonates, clay and other foreign materials, which may have negative effects on the pool water quality.

The filter installed with a specified sand media and bed height shall be in accordance with Clause 4.

4.3.4 Alternatives to sand media

In case of replacing sand by an alternative granular media, the manufacturer of the same shall provide the specification parameter indicated before.

Moreover, the filter installed with the specified alternative media and bed height, shall also be in accordance with Clause 4.

4.4 Maximum operating pressure (MOP)

The filter's MOP shall be greater than or equal to the maximum manometric head of the pump of the filtration unit.

4.5 Turbidity reduction efficiency

The turbidity reduction efficiency shall be 50 % or greater

The testing procedure for measuring the turbidity reduction efficiency shall be carried out according to Clause 7.

4.6 Retention capacity

The retention capacity shall be greater than or equal to the value specified by the manufacturer.

The testing procedure for measuring the retention capacity shall be carried out according to Clause 7.

4.7 Backwashing/Replacement/Cleaning Criteria

4.7.1 General

For different types of filtration, different backwash conditions shall be applied to ensure the removal of debris and other accumulated matter out of the filter.

For filtration systems equipped with a clogging indicator (e.g. pressure gauge, flow meter, etc.), the cleaning differential pressure, shall be equal to the differential pressure obtained at the cleaning limit value as defined in 3.19.

Independent of the clogging indicator, or if there is no clogging indicator installed, the filter shall be designed so that backwashing regularly to prevent blocking and contamination is possible.

Consider the backwashing or cleaning requirements given in 4.7.2 and 8.3.

Any backwash water shall be discharged into an appropriate drain close to the filter and the water disposed according to local regulations.

Backwash pipework fitted with a system (e.g. viewing glass) allows the operator to properly gauge the efficiency of the backwash. If there is no such system, a minimum cleaning/backwash procedure shall be specified by the manufacturer.

4.7.2 Specific backwash conditions

4.7.2.1 Single or multilayer filter

For single or multilayer filters with sand, crushed glass or other graded aggregated filter material, the backwash rate should be as specified by the manufacturer for the filter taking into account the filter media specifications in use.

The filter media loading shall allow the media to expand freely during backwash operation; for instance, a minimum expansion of 10 % is required for sand.

For single or multilayer filters with sand, crushed glass or other graded aggregated filter material, the bed expansion of each efficient filter layer shall be min. 10 % during backwash.

If no means for indicating the clogging level and backwashing such as pressure gauge, flow meter, etc. are included, backwashing should be carried out according to the manufacturer's instructions or for a minimum of 3 min.

4.7.2.2 Cartridge filter

Cartridge filters can be cleaned automatically or manually. The duration of the cleaning process is until the visible debris on the surface is washed away or in accordance with the manufacturer's recommendations.

4.7.2.3 Pre-coat filtration using diatomaceous earth (DE)

A pre-coat media-type filter shall be designed so that wash water, dislodged filter aid, and dirt may be removed from the filter tank to a suitable drain. The cleaning process could be done by backwash or by manual cleaning of cartridge filters. After the cleaning process, fresh DE shall be added.

A complementary system shall be added to collect the diatomaceous earth after the backwash operation.

4.7.2.4 Other filtration systems

To remove debris and accumulated matter properly the backwash conditions shall be applied according to manufacturer's recommendations.

In any case, the flow rate, duration, pressure and possible backwash disinfection applied shall be sufficient enough to avoid permanent accumulation of debris especially organic matter (e.g. microorganisms).

4.8 Construction requirements

Both the inside and the outside of the filter body shall be easy accessible for maintenance and inspection reasons.

The material used for the filter body, piping and other filter components that are in contact with water shall be suitable with respect to not encouraging bacterial growth, corrosion, and dissolving into or otherwise influencing the pool water quality.

The geometry of the filter body may vary (e.g. cylindrical shaped, rectangular shaped). The effective filter layer shall be geometrically uniform to gain maximum filtration efficiency.

5 Pressure resistance (pressure filter)

5.1 General

These tests are applicable to filter vessels designed to operate at pressures larger than the ambient pressure.

Filter vessels which are newly designed shall be tested according to 5.2, 5.3 and 5.4.

If there are changes in construction, design and equipment of existing filter vessels, the tests according to 5.2, 5.3 and 5.4 shall be repeated.

It is recommended that a filter is periodically taken off the production line and tested according to 5.2, 5.3 and 5.4 (random sample survey).

The following order of testing shall be followed:

a) static pressure resistance test;

b) cyclic pressure variation resistance test;

c) determination of the burst pressure.

The testing a) and b) shall be carried out with the same filter.

5.2 Static pressure resistance test

5.2.1 Principle

The filter body is subjected to increases in line pressure following the closing of valves, the starting of a pump on a closed valve, or the clogging of the filter element or medium. The purpose of this test is to determine the capacity of a swimming pool filter body to resist high static pressure, and to determine, if appropriate, its failure mode.

5.2.2 Test pressure

The filter vessel shall be tested at a test pressure p_{T}

$$p_T = F_p \cdot p \tag{5}$$

where

ρ is the maximum allowed operating pressure;

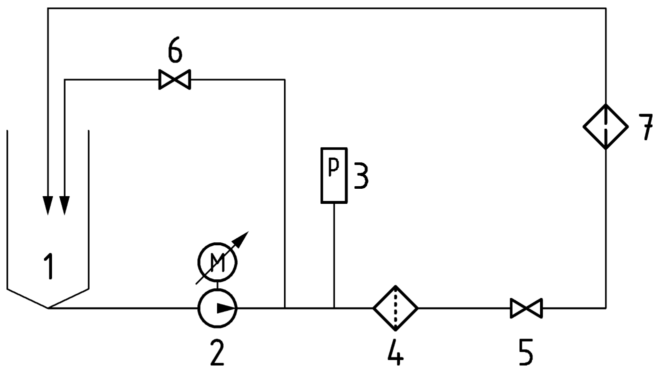
F_{p} is the test pressure factor.

Test factor F_p shall be at any time ≥ 1,43.

5.2.3 Equipment and reagents

5.2.3.1 Test bench

A test bench principle is shown in Figure 1. Any other type of test bench allowing static pressure (hand-operated test pump, etc.) to be generated in the filter is accepted.



Key

ρ pressure
1 test container (volume at least equal to 130 % of the volume of the test filter body)
2 pressure source
3 pressure sensor
4 test filter
5 back pressure valve
6 bypass valve
7 heat exchanger

Figure 1 — Diagram of the test bench for the static pressure resistance of the filter body

5.2.3.2 Test liquid

Disinfected tap water or pool water.

5.2.4 Procedure

a) Install the filter body on the test bench;

b) Attach the pressure sensor to the liquid inlet point on the test filter body;

c) Fill the installation and the test filter with water and release any air from the test bench;

d) Adjust the water temperature to (28 ± 2) °C and circulate the water through the filter until stabilization;

e) Gradually increase the pressure until the manometer shows the test pressure ± 10 kPa (±0,1 bar) or any other value specified (greater than or equal to the test pressure) for the test and maintain it for 5 min ± 30 s.

5.2.5 Acceptance criteria

When subjected to a static pressure resistance test as defined in 5.2, the filter body shall not exhibit any visible and persistent sign of leakage or deformation that may compromise its proper operation.

5.3 Cyclic pressure variation resistance test

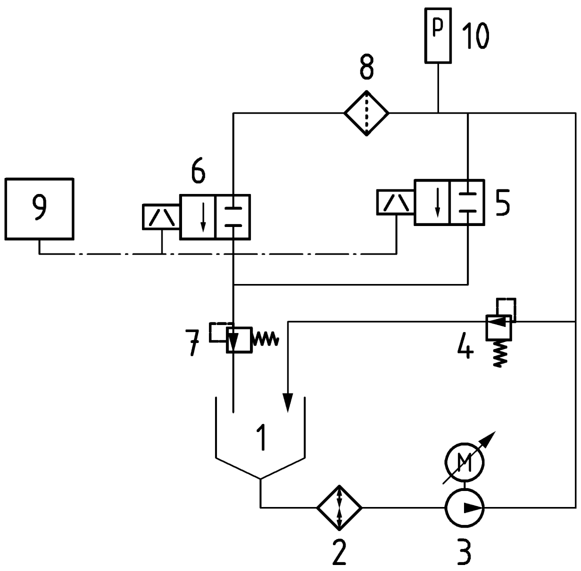
5.3.1 Principle

In service, the filter body is exposed to pressure fluctuations following the closing/opening of valves and the starts/stops of pumps which vary the line pressure. The purpose of the test is to vary the pressure upstream of the filter body several times in order to simulate its fatigue during its normal service life.

5.3.2 Equipment and products

5.3.2.1 Test bench

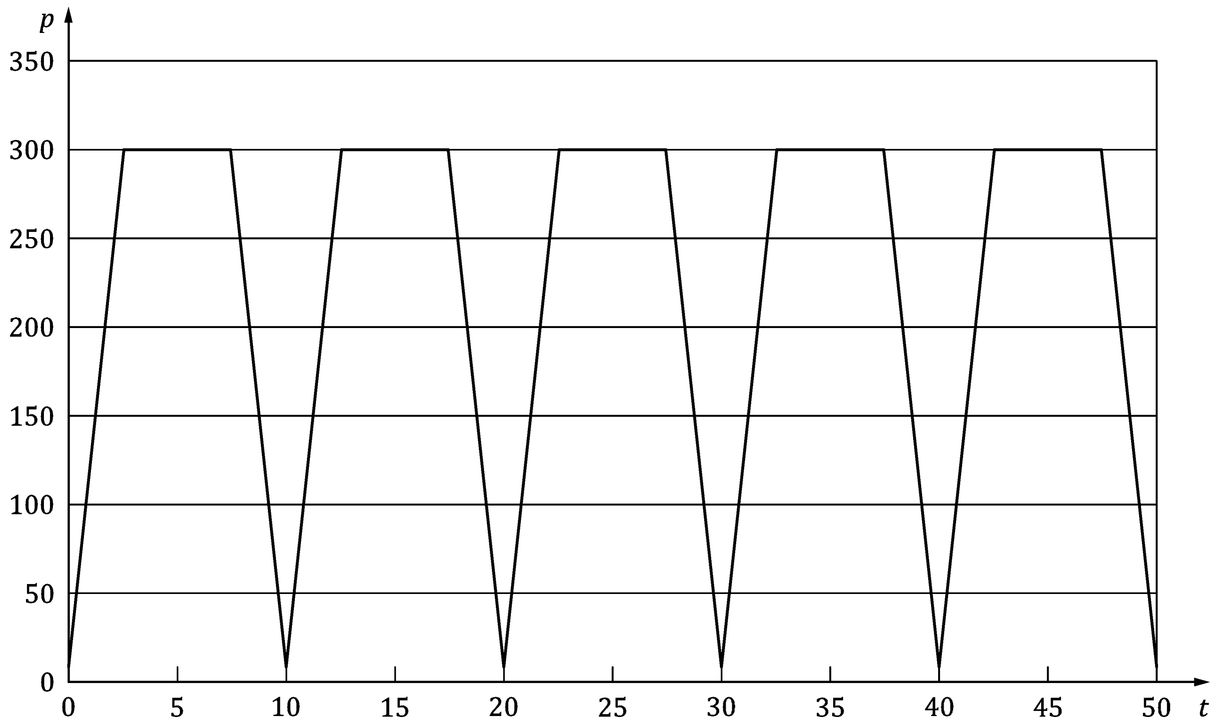
A test bench principle is shown in Figure 2. Any other type of test bench allowing a cyclic pressure rise to be generated is accepted.



Key

ρ	pressure
1	test container
2	heat exchanger
3	pressure source
4	inlet pressure regulating valve
5	solenoid valve
6	solenoid valve
7	back pressure valve
8	test filter
9	timer and electromagnetic sequence counter regulating the operation of solenoid valves 5 and 6
10	pressure sensor

Figure 2 — Diagram of the test bench for the resistance to fatigue caused by cyclic pressure variations



Key

ρ upstream amount in kPa

t time in s

Figure 3 — Typical pressure cycle 6 cycles/min

5.3.2.2 Test liquid

Disinfected tap water or pool water.

5.3.3 Operating protocol

a) Install the filter body on the test bench;

b) Attach the pressure sensor to the liquid inlet point on the test filter body;

c) Adjust the temperature to the expected operation temperature (28 ± 2) °C;

d) Start the pump by checking that the pressure regulating valves referenced 4 and 7 as well as the solenoid valves referenced 5 and 6 are open;

e) Allow the bench to function until all of the air is expelled from the system. Close the valve 7 and the solenoid valves 5 and 6 and adjust the valve 4 until the pressure in the test filter body reaches its MOP ± 10 kPa (±0,1 bar) or any other value specified by the manufacturer;

f) Adjust the solenoid valves 5 and 6 so as to obtain the pressure wave shape indicated in Figure 3. Adjust the valve 7 so as to obtain a pressure differential of 10 kPa to 20 kPa to avoid the negative pulses of the outlet pressure;

g) Reset the counter 9 to zero;

h) Circulate the cooling fluid through the heat exchanger 2 so as to adjust the temperature to the value specified in c);

i) Continue the test, visually checking for signs of a possible failure at regular intervals, until 10,000 cycles have been completed at the frequency of 0,1 Hz ± 20 % or until the test filter body breaks or until a leak occurs outside it;

j) To stop the test, open the valve 4 fully and stop the pump.

5.3.4 Acceptance criteria

When subjected to a cyclic pressure variation test as defined in 5.3, the filter body shall not exhibit any visible and persistent sign of leakage or deformation that may compromise its proper operation.

5.3.5 Expression and presentation of results

In addition to a reference to this document, the test report shall include the following information:

— name of the testing laboratory, where the tests are carried out;

— operator name;

— test date;

— person responsible for placing the product on the market;

— product code and/or reference;

— test temperature;

— number of cycles specified and number of cycles applied;

— upstream pressure fluctuation curve;

— observations.

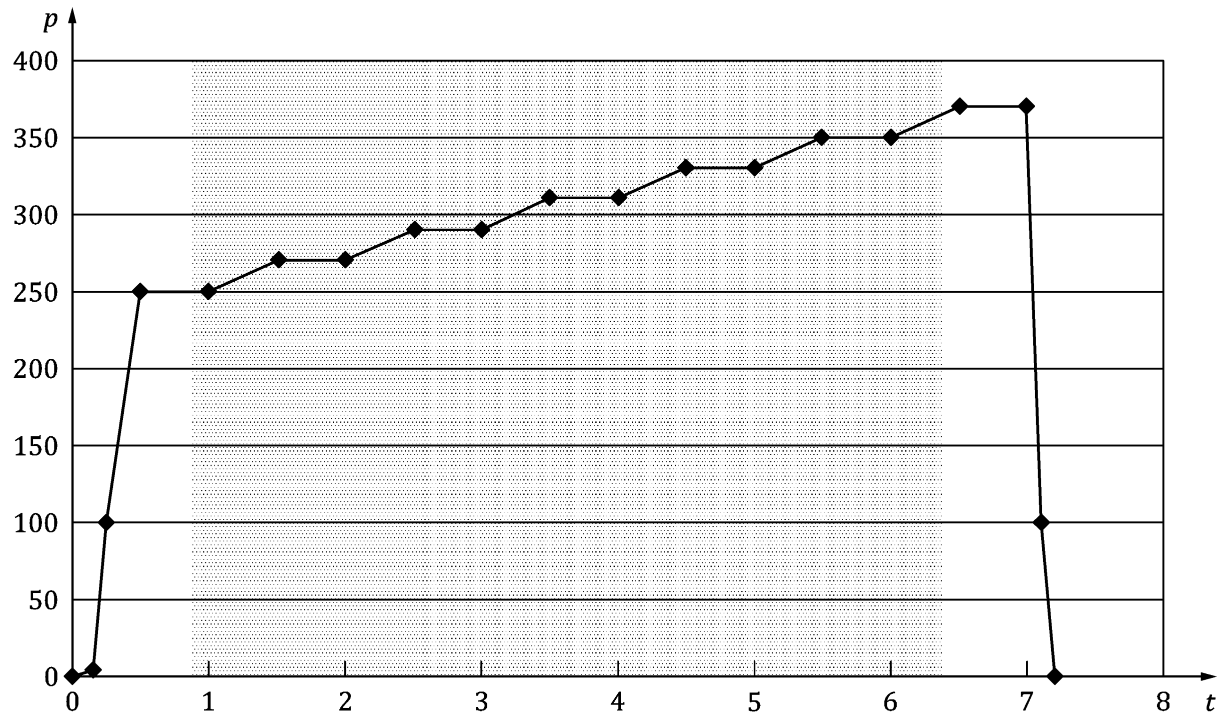
— conformity/non conformity

An example of test report is given in Annex B.

5.4 Determination of the burst pressure

5.4.1 Procedure

Perform the static pressure test as defined in 5.2 on a new filter and continue increasing the pressure while recording the pressure upstream of the filter in steps of 20 kPa (0,2 bar) maintained for 30 s until the pressure drops or stabilizes (increase by less than 5 kPa (0,05 bar) or until a leak occurs outside of the filter.



Key

ρ upstream in kPa

t time in min

Figure 4 — Typical pressure rise curve to determine the burst pressure of a filter body

5.4.2 Acceptance criteria

The burst pressure is greater than that specified (1,5 x MOP or other greater value specified by the manufacturer) if there is no leak of the test liquid 30 s after the specified pressure is reached.

The burst pressure of the test filter is that measured in 5.4.1 for which a leak was observed on the test filter.

5.4.3 Test report

In addition to a reference to this document, the test report shall include the following information:

— name of the testing laboratory;

— operator name;

— test date;

— person responsible for placing the product on the market;

— product code and/or reference;

— test temperature;

— specified pressure (1,5 × MOP or any other pressure specified);

— final upstream pressure (burst pressure);

— pressure rise curve as a function of time;

— failure type(s) (with associated photos).

6 Pressure resistance (negative pressure filter)

6.1 General

These tests are applicable to filter vessels designed to operate at pressures lower than the ambient pressure.

Filter vessels which have a new design shall be tested according to 6.3, 6.4 and 6.5.

If there are changes in construction, design and equipment of existing filter vessels, the tests according to 6.3, 6.4 and 6.5 shall be repeated.

It is recommended that a filter is periodically taken off the production line and tested according to 6.3, 6.4 and 6.5 (random sample survey).

The following order of testing shall be followed:

a) static negative pressure resistance test;

b) cyclic negative pressure variation resistance test;

c) determination of the negative collapsing pressure.

The testing a) and b) shall be carried out with the same filter.

6.2 Test pressure

Owing to the vapour pressure of water at atmospheric pressure, it is not possible to generate a negative pressure lower than 80 kPa (0,8 bar).

The test pressure shall be according to the lowest possible pressure (negative pressure) of the pump which is sold together with the filtration unit. In case the filtration unit is sold separately, the test negative pressure shall be 50 kPa (0,5 bar).

6.3 Static negative pressure resistance test

6.3.1 Principle

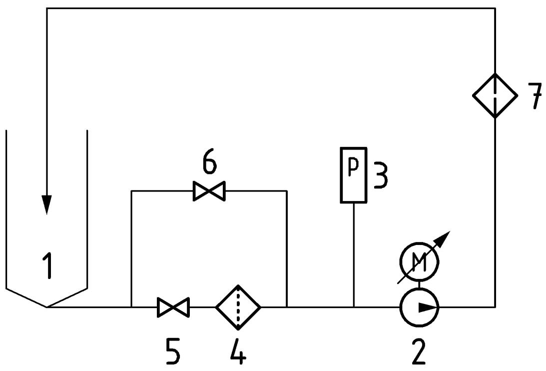
The filter body is subjected to a negative line pressure following the blanking or clogging of the filter element or medium. The purpose of this test is to determine the capacity of a swimming pool filter body to resist static negative pressure, and to determine, if appropriate, its failure mode.

6.3.2 Equipment and reagents

6.3.2.1 Test bench

A test bench principle is shown in Figure 5.

Any other type of test bench allowing negative static pressure (hand operated test pump, etc.) to be generated in the filter is accepted.



Key

ρ pressure
1 test container (with a volume at least equal to 130 % of the volume of the test filter body)
2 negative pressure source
3 negative pressure or absolute pressure sensor
4 test filter body
5 negative pressure valve
6 bypass valve
7 heat exchanger

Figure 5 — Diagram of the test bench for the static negative pressure resistance of the filter body

6.3.2.2 Test liquid

Disinfected tap water or pool water.

6.3.3 Procedure

— Install the filter body on the test bench and install a blanking plate instead of the filter element;

— Attach the negative pressure sensor to the liquid outlet point on the test filter body;

— Fill the installation and the test filter with water and release any air from the test bench;

— Adjust the water temperature to (28 ± 2) °C and circulate the water through the filter until stabilization;

— Gradually increase the negative pressure until the manometer shows the test pressure ± 10 kPa (±0,1 bar) or any other value specified (lower than or equal to the test pressure) for the test and maintain it for 5 min ± 30 s.

6.3.4 Acceptance criteria

When subjected to a static negative pressure resistance test as defined in 6.3, the filter body shall not exhibit any visible and persistent sign of leakage or deformation that may compromise its proper operation.

6.4 Cyclic negative pressure variation resistance test

6.4.1 Principle

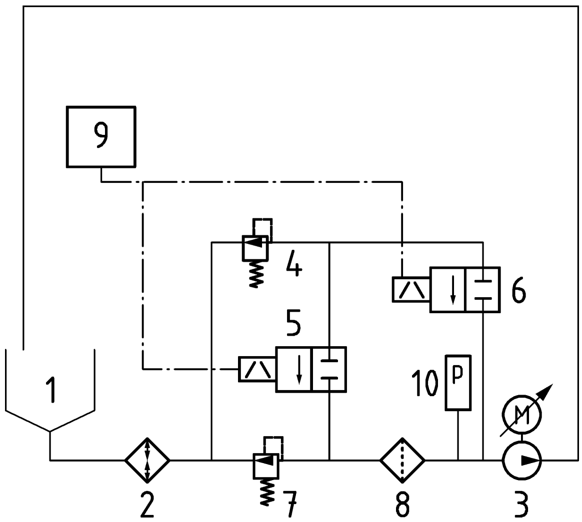
In service, and when installed upstream of the circulation pump, the filter body is exposed to negative pressure fluctuations following the clogging of the filter element or medium and to pump starts/stops which vary the line pressure. The purpose of the test is to vary the negative pressure in the filter body several times in order to simulate its fatigue during its normal service life.

6.4.2 Equipment and products

6.4.2.1 Test bench

A test bench principle is shown in Figure 6.

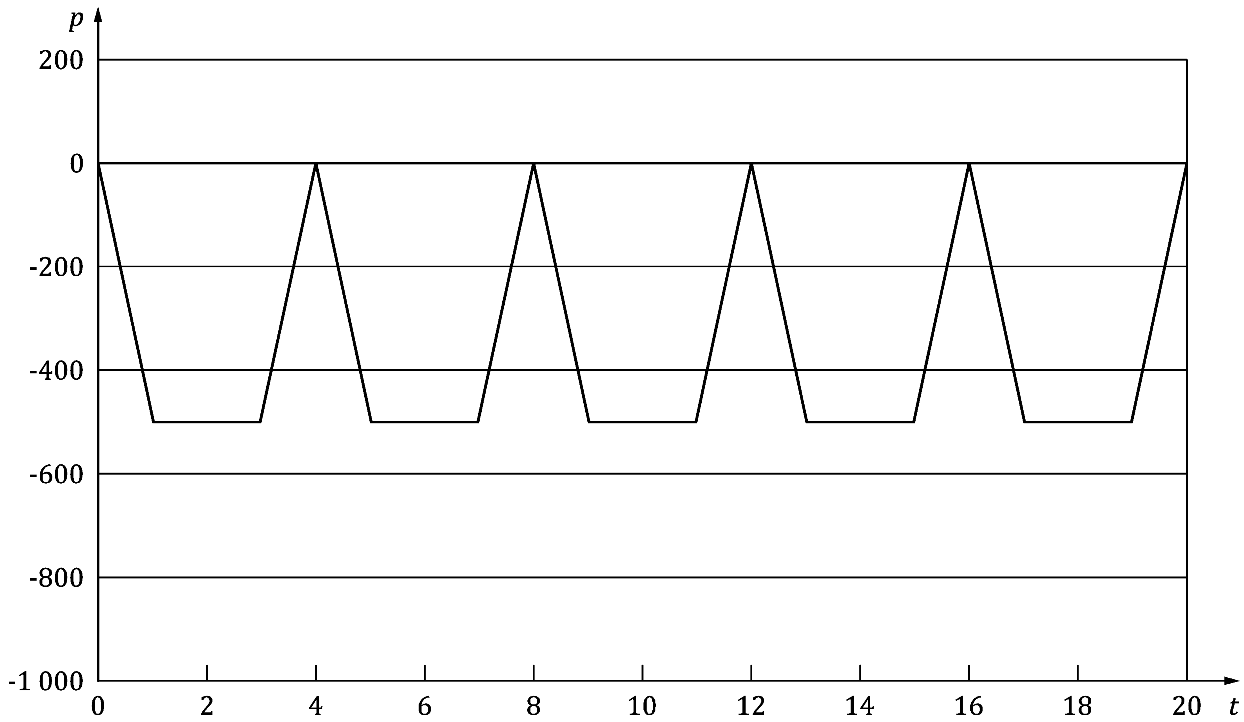
Any other type of test bench allowing a negative cyclic pressure rise to be generated is accepted.



Key

ρ pressure
1 test container
2 heat exchanger
3 negative pressure source
4 negative inlet pressure regulating valve
5 solenoid valve
6 solenoid valve
7 back pressure valve
8 test filter body
9 timer and electromagnetic sequence counter regulating the operation of solenoid valves 5 and 6
10 absolute pressure sensor

Figure 6 — Diagram of the test bench for the resistance to fatigue caused by cyclic negative pressure variations



Key

ρ upstream (relative pressure) in kPa

t time in s

Figure 7 — Example of a typical negative pressure cycle (relative pressure)

6.4.2.2 Test liquid

Disinfected tap water or pool water.

6.4.3 Operating protocol

a) Install the filter body on the test bench and install a blanking plate to block the inlet port of the filter element;

b) Attach the pressure sensor to the liquid outlet point on the test filter body;

c) Adjust the temperature to (28 ± 2) °C;

d) Start the pump by checking that the pressure regulating valves referenced 4 and 7 as well as the solenoid valves referenced 5 and 6 are open;

e) Allow the test bench to function until all of the air is expelled from the system. Close the valve 7 and the solenoid valves 5 and 6 and adjust the valve 4 until the pressure in the test filter body reaches its maximum operating negative pressure (MONP) ± 10 kPa (±0,1 bar) or any other value specified by the manufacturer;

f) Adjust the solenoid valves 5 and 6 so as to obtain the pressure wave shape shown in Figure 7. (Adjust the valve 7 so as to obtain a pressure differential of 10 kPa to 20 kPa to avoid the negative pulses of the outlet pressure);

g) Reset the counter 9 to zero;

h) Circulate the cooling fluid through the heat exchanger 2 so as to adjust the temperature to the value specified in c);

i) Continue the test, visually checking for signs of a possible failure at regular intervals, until 10,000 cycles have been completed at the frequency of 0,1 Hz ± 20 % or until the test filter body breaks or air intake or filter body water losses occurs;

j) To stop the test, open the valve 4 fully and stop the pump.

6.4.4 Acceptance criteria

When subjected to a cyclic negative pressure variation test as defined in 6.4, the filter body shall not exhibit any visible and persistent sign of air intake, water losses or deformation that may compromise its proper operation.

6.4.5 Expression and presentation of results

In addition to a reference to this document, the test report shall include the following information:

— name of the testing laboratory;

— operator name;

— test date;

— person responsible for placing the product on the market;

— product code and/or reference;

— test temperature;

— number of cycles specified and number of cycles applied;

— downstream pressure fluctuation curve;

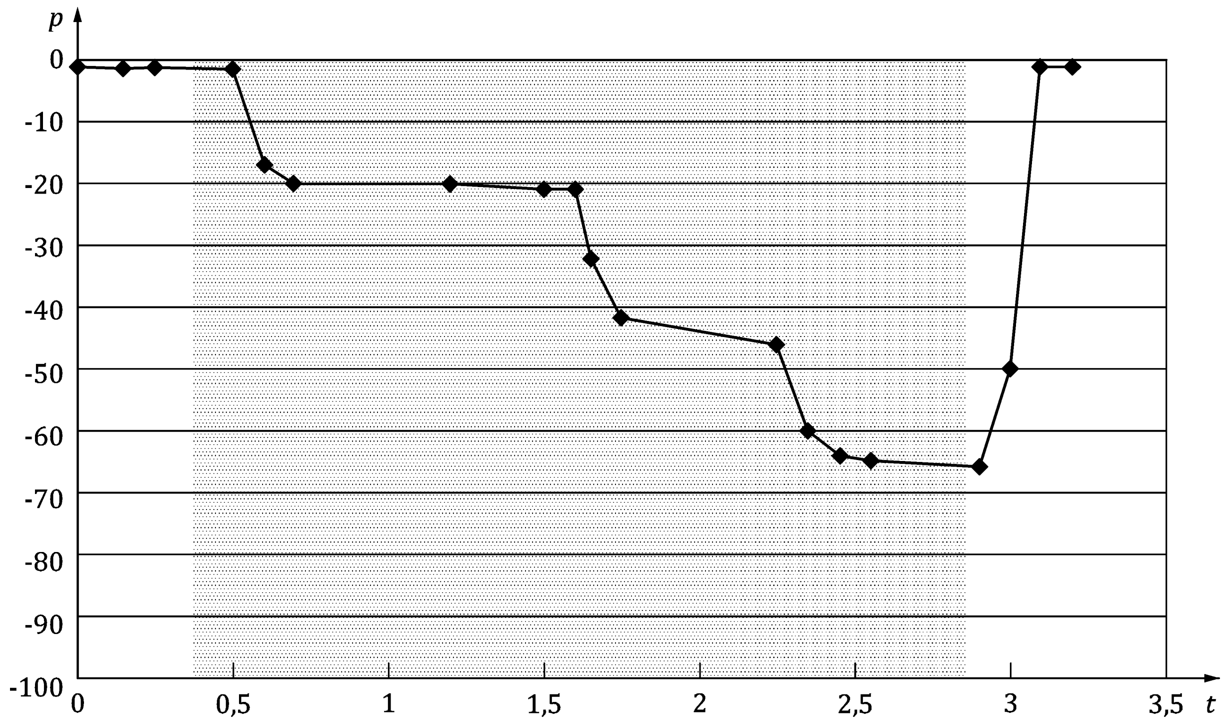
— observations.

An example of a test report is given in Annex B.

6.5 Determination of the negative collapsing pressure

6.5.1 Procedure

Perform a static negative pressure test as defined in 6.3 on a new filter and continue decreasing the (negative) pressure while recording the (negative) pressure downstream of the filter to ensure a negative pressure drop in steps of 20 kPa (0,2 bar) maintained for 30 s until the pressure increases or stabilizes (drop of less than 5 kPa (0,05 bar)) or until the sound made by an air intake into the filter body is heard or until air bubbles appear as the water returns to the test container.



Key

ρ upstream (relative pressure) in kPa

t time in min

Figure 8 — Typical pressure drop curve to determine the negative collapsing pressure of a filter body (relative pressure)

6.5.2 Acceptance criteria

The negative collapsing pressure is higher than that specified (1,5 × MONP or any other negative pressure specified) if no air intake or water loss is detected from the filter body.

The negative collapsing pressure of the test filter is that measured in 6.5.1 for which an air intake or water loss was observed in the test filter.

6.5.3 Test report

In addition to a reference to this document, the test report shall include the following information:

— name of the testing laboratory;

— operator name;

— test date;

— person responsible for placing the product on the market;

— product code and/or reference;

— test temperature;

— specified pressure (1,5 × MONP or any other negative pressure specified);

— final downstream negative pressure (specify if this is the negative collapsing pressure or not);

— (negative) pressure drop curve as a function of time;

— failure type(s) (with associated photos).

7 Test methods for filtration efficiency

7.1 Principle

This section is divided into two parts:

— first part (7.2) is compulsory for filtration units or filters to claim the compliance with this standard;

— second part (7.3) is optional, but shall be utilized for any further claims made on the performance of the filtration unit or filter.

7.2 Turbidity reduction and contaminant retained mass

7.2.1 Purpose

The purpose of this test is:

— to measure the turbidity reduction capability of a filtration unit or a filter with their respective filtration medium or element recommended or supplied by the producer, and to verify that it fulfils the filtration efficiency requirements as specified in 4.5;

— to record the retained mass of the contaminant of the filtration unit or filter as a function of the differential pressure.

7.2.2 Principle

The minimum performance requirements of the filter to be tested are determined, by subjecting the filter to a constant flow rate and measuring the following:

— the turbidity reduction efficiency over a defined amount of 20 recirculation cycles, and

— its partial retention capacity after 20 recirculation cycles ;

The flow rate shall be the filter nominal flow rate specified by the manufacturer.

The turbidity reduction efficiency is calculated from the turbidities measured upstream of the filter at the beginning and end of the test.

The contaminant retained mass is determined to quantify a partial retention of the filter.

For filter units supplied with a pump, which is not able to be operated in order to deliver a constant flow rate, the test shall be done on the filter unit using an external test pump capable of constantly delivering water at the nominal flow rate through the filter

7.2.3 Equipment and products

— Test fluid: freshly prepared tap water maintained at (23 ± 3)°C, less than 1,5 FNU;

— Test dust: grade A4 silica dust according to ISO 12103-1 with a size grading of 0 μm to 200 μm;

— Precision balance with an accuracy of ± 0,01 g;

— Turbidimeter (required accuracy from 0 FNU to 10 FNU is ± 0,5 FNU; required accuracy above 10 FNU is ± 5 % of the reading or ± 1 FNU, whichever is greater);

— Chronometer accurate to the nearest second;

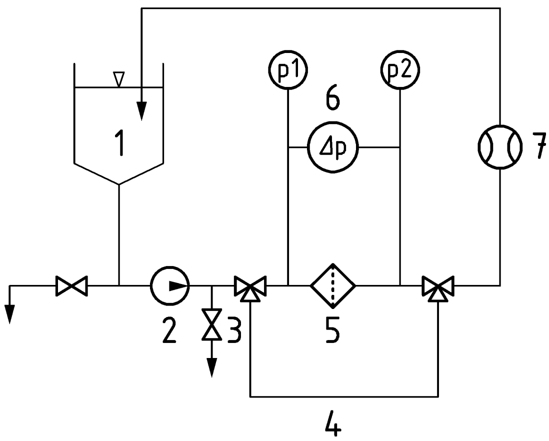
— Test bench as according to Figure 9 or Figure 10;

— Water tank and pump system capable of constantly delivering water at the nominal flow rate through the filter;

— Flow meters with an accuracy of ± 5 % of the reading;

— Two digital precision pressure gauges with an accuracy class 2,5 according to EN 837-1;

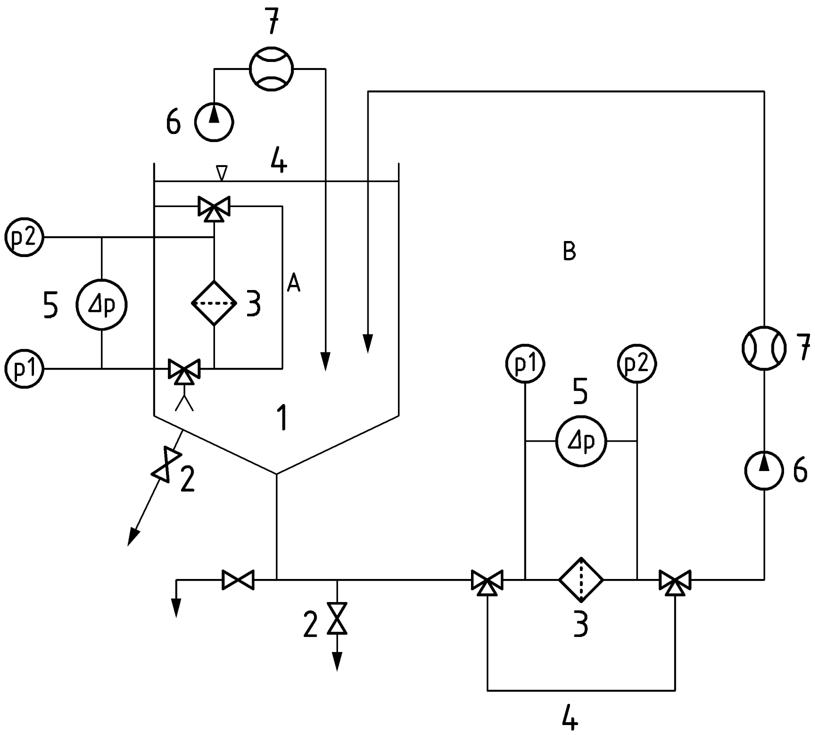
— If needed, equipment for the measurement of the test dust concentration defined in EN 872.



Key

ρ pressure
1 test reservoir
2 test pump
3 upstream sampling tap
4 test filter bypass line
5 test filter
6 upstream, downstream and differential pressure indicator
7 flow meter

Figure 9 — Turbidity reduction test stand schematic for pressure filter (at pump discharge)



Key

ρ pressure

A immerged suction filter test circuit

B suction filter test circuit

1 test reservoir

2 upstream sampling valve

3 test filter

4 test filter bypass line

5 upstream, downstream and differential pressure indicator

6 test pump

7 flow meter

Figure 10 — Turbidity reduction test stand schematic for a negative pressure filter (pump suction)

NOTE The pressure gauges are installed as close to the test filters as possible.

7.2.4 Turbidity reduction test

7.2.4.1 Circuit preparation and filter conditioning

a) For granular media filter, wash and rinse the filter until the turbidity of the backwashing water going out from the filter is less than 1,5 FNU.

   This operation should be carried out on a different installation from the test bench to avoid contaminating it with the residue from washing the material.

b) Clean the entire test circuit (including the filter bypass and without the filter to be tested) by filling the test bench with clean water (e.g. tap water) and circulating it for 5 min. A separate clean-up filter may be used if needed. Take a water sample for turbidity measurement, if the turbidity is > 1,5 FNU, repeat the cleaning cycle.

NOTE Instead of cleaning with a specific filter you can drain the bench and repeat the b)

c) Once the turbidity is less than 1,5 FNU drain completely the test bench circuit

d) Ensure that the entire circuit and the filter to be tested are empty of water and set the filter on the bench. Fill the test bench with a volume V (in l) of fresh water comprised between the following formulae:

$$V_{min} = 0{,}6 \,.\, Q + V_{\text{Filter}} \tag{6}$$

$$V_{max} = 3{,}6 \,.\, Q + V_{\text{Filter}} \tag{7}$$

where

Q	is the flow rate in l/min;
V_{Filter}	is the volume contained by the filter body in l, (without the media)

NOTE Q (l/min) = 16,66 . Q (m^3/h).

e) Circulate the water for 5 min through the filter and ensure that the turbidity is < 1,5 FNU. If the turbidity is > 1,5 FNU, repeat the complete cleaning cycle from b).

f) Calculate and prepare the amount of contaminant m (in mg) to be introduced in the test reservoir according to:

$$m = 50 \,.\, V \tag{8}$$

where

V	is the volume in l chosen in d)

7.2.4.2 Test procedure

a) Operate the pump at the defined constant nominal flow rate.

b) Record the flow rate, the upstream pressure and the differential pressure (Δp) of the test filter and the water temperature. Then, by pass the filter or the filter element.

Depending of the filter technology, the filter element may be removed instead of being by-passed.

c) Introduce the whole calculated amount of contaminant prepared above into the test reservoir and circulate during at least the time t (in min) needed to circulate one tested volume, according to the following

$$t = V / Q \tag{9}$$

where

V	is the volume in l chosen in 7.2.4.1 d)
Q	is the nominal flow rate in l/min

NOTE Q (l/min) = 16,66 . Q (m3/h).

d) Take a sample of water and measure its turbidity. Let the pump operate for a duration of 10 cycles, and take a sample to measure the turbidity once again. The variation between the two measurement results shall be equal or less than ± 0,5 FNU.

If the variation is greater than 0,5 FNU, there is a pollution inside the test bench or the test contaminant has not been homogenously distributed. In that case, the test bench design and/or condition should be analyzed.

e) If the filter is bypassed, then this measured turbidity differs from $TB_{us,0}$ that shall be recorded. $TB_{us,0}$ shall be corrected according to the following:

$$TB_{us,0} = TB_{us,restricted} \cdot [1 - (V_{bypass} / V)] \quad (10)$$

where

$TB_{us,restricted}$ is the measured turbidity in FNU, resulting from the dilution of the mass of contaminant m in the test bench volume V minus the by-pass volume V_{bypass}

V_{bypass} is the volume in l of the bypass, including pipes, fittings and filter with its media. If needed, V_{bypass} shall be preferably determined before starting the test

V is the volume in l chosen in 7.2.4.1 d)

f) After that, simultaneously switch upstream and downstream valves from the bypass to the filtration circuit and start the chronometer.

Depending of the filter technology, the filter element may be set in the test bench if it has been removed in 7.2.4.2 b).

g) Ensure that the pollutants are kept in suspension during the whole test time.

h) Record the test flow rate (Q_e), the water temperature (23 ± 3) °C, the upstream pressure and the differential pressure ($\Delta\rho$) at the terminals of the filter and take a sample upstream of the test filter to measure its turbidity every 2 cycles at minimum for a duration of 20 cycles, or until the filter is clogged (whichever comes first).

NOTE For the test, the filter is clogged when the MOP or MONP is reached.

i) Stop the test, disassemble the test filter and clean the test system.

7.2.5 Simplified 20 cycles retention test (dp20)

7.2.5.1 General

This test is based on the measurement of the differential pressure vs. the injected mass of contaminant. It consists of a partial retention capacity evaluation of the filter to be tested after a continuous injection of contaminant during 20 recirculation cycles at the constant nominal flow rate. This test shall be done with new filter media. At the end of the test, the differential pressure $\Delta\rho_2$, the retained mass of contaminant injected m_R, the net differential pressure $\Delta(\Delta\rho)$ and the test time are recorded. The end pressure applied on the filter body shall not exceed the maximum pressure specified / allowed by the manufacturer for this test. If the maximum allowed pressure is reached before the 20 recirculation cycles, this should be recorded. This test is only applicable if the acceptance criteria of the turbidity reduction test were achieved.

If during this test, the filter shows ruptures that may compromise its proper operation, then the test is considered as failed.

7.2.5.2 Calculation of the contaminant injected mass

Calculate the mass of contaminant to be manually added to the test reservoir every cycle m_i by multiplying the test flow Q_t by the test concentration C_t:

$$m_i = Q_t \cdot C_t \tag{11}$$

where

m_i is the injected mass per cycle in g/cycle;

Q_t is the filter test flow rate in l/min;

C_t is the contaminant concentration (0.05g/l)

NOTE Qt (l/min) = 16,66 . Qt (m3/h).

7.2.5.3 Test procedure

a) Take a new filter for this test. Before testing and if necessary (see 7.2.5.4.3), record the mass of the dry filter element.

b) Prepare the circuit and condition the new filter to be tested following the same procedure as described in 7.2.4.1, a) to e).

c) Operate the pump at the defined constant flow. For the test, the pump shall be able to reach the maximum operating pressure of the filter at its maximal nominal flow rate.

d) Record the initial values of the upstream pressure and the differential pressure (Δp) of the test filter and the water temperature.

e) Simultaneously start the chronometer and introduce, into the test reservoir, the above defined contaminant mass at the beginning of first cycle and each cycle for a duration of maximum 20 cycles or until the filter is clogged (whichever comes first). An injection system may be used for this test.

f) Ensure that the pollutants are kept in suspension during the whole test time.

g) Record the test flow rate (Q_t) and make sure it is constant (± 1 % for the measuring device; ± 5 % around the nominal flow rate value), the water temperature (23 ± 3) °C, the upstream pressure, the differential pressure ($\Delta \rho$) at the terminals of the filter every 2 cycles at minimum for the duration of the test (total test time).

h) After the last contaminant addition, continue the recirculation cycle until Δp has stabilized (± 5 % over 3 min). Record the corresponding time as the total test time. If needed, take a sample at the sampling valve to measure the residual concentration of contaminant.

i) Stop the test, disassemble the test filter (if required) and clean the test system.

7.2.5.4 Determination of the retained mass of contaminant

7.2.5.4.1 General

Depending of the filter technology, the determination of the retained mass of contaminant may be achieved either by the determination of suspended solids method either by a method of mass.

7.2.5.4.2 Determination of suspended solids method

a) From the sample collected in 7.2.5.3 h), calculate the non-retained mass of contaminant.

$$m_{\mathrm{NR}} = C_F \, . \, V \qquad (12)$$

where

C_{F}	is the final concentration of contaminant in the test system according to EN 872, in g/l;
V	is the volume in l chosen in 7.2.4.1 d)

b) Calculate the retained mass of contaminant

$$m_{\mathrm{R}} = m_{\mathrm{i}} \, . \, t - m_{\mathrm{NR}} \qquad (13)$$

where

m_{R}	is the retained mass in g;
m_{i}	is the mass injected each cycle in g/cycle;
t	is the number of cycle of the dp20-test (max. 20 cycles);
m_{NR}	is the non-retained mass in g

7.2.5.4.3 Method of mass

a) At the end of the dp20 test, carefully remove the tested filter element with the contaminant collected from the filter body and let it completely dry until stabilization of its mass (±1 % over 3 days, 30°c ± 5°c, Relative humidity between 45 and 65 %)

b) Record the mass of the dry filter element with the contaminant after the test and calculate the retained mass of contaminant

$$m_{\mathrm{R}} = \mathrm{m}_{\mathrm{feat}} - \mathrm{m}_{\mathrm{febt}} \qquad (14)$$

where

m_{R}	is the retained mass in g
$\mathrm{m}_{\mathrm{feat}}$	is the mass of the dry filter element after the dp20 test, with the contaminant, in g
$\mathrm{m}_{\mathrm{febt}}$	is the mass of the clean dry filter element before the dp20 test (recorded in 7.2.5.3 a))

7.2.6 Expression and presentation of results

7.2.6.1 Curves

7.2.6.1.1 Turbidity reduction test

Plot the following curves:

a) Evolution of the differential pressure at the terminals of the filter (filter head loss) as a function of time;

b) Evolution of upstream turbidity as a function of time (recirculation cycles).

7.2.6.1.2 Dp20 test

Plot the following curve:

Evolution of the differential pressure at the terminals of the filter (filter head loss) as a function of time.

7.2.6.2 Filter characteristics

Record the values of the following characteristics of the filter tested:

a) the turbidity reduction efficiency (in %) after the 20 recirculation cycles;

b) the initial differential pressure Δp_0;

c) the final differential pressure Δp_1 after the turbidity reduction test;

d) the final differential pressure Δp_2 after the dp20 test;

e) the retained mass of contaminant m_R after the dp20 test.

f) The tested volume and the nominal flow rate (in m^3/h) applied for the reduction turbidity test and the dp20 test.

7.2.7 Test report

7.2.7.1 Information given in the report

The report shall include at least the following information:

— Laboratory references;

— References and characteristics of the tested filter/pump unit;

— References of the filter material used (see below).

— References of the present standard

— Results and curves mentioned in 7.2.6

7.2.7.2 Information about filter media

7.2.7.2.1 General

For a given filter setup, the following media specification as well as installation conditions shall be provided.

7.2.7.2.2 Granular media

a) Type of media filter;

b) Height and weight of filter media within the filter;

c) Manufacturer's reference as made available on the market (if applicable);

   1) Chemical composition;

   2) Density *D* of the material (in kg/m^3) (also called specific gravity);

   3) Bulk density in kg/m^3:

   4) Grain size range according to EN 12902 (in mm);

   5) Uniformity coefficient C_u.

In case of a multilayer filter, the specification of the media for each layer shall be specified.

7.2.7.2.3 Alternative granular media

In case of replacing sand by an alternative granular media, the test report shall indicate the different specification parameters indicated before.

7.2.7.2.4 Nonwoven and other fabric media

— Brand;

— Model number;

— Batch number (if applicable) or date of manufacturing.

7.3 Filtration efficiency and retention capacity

7.3.1 Principle

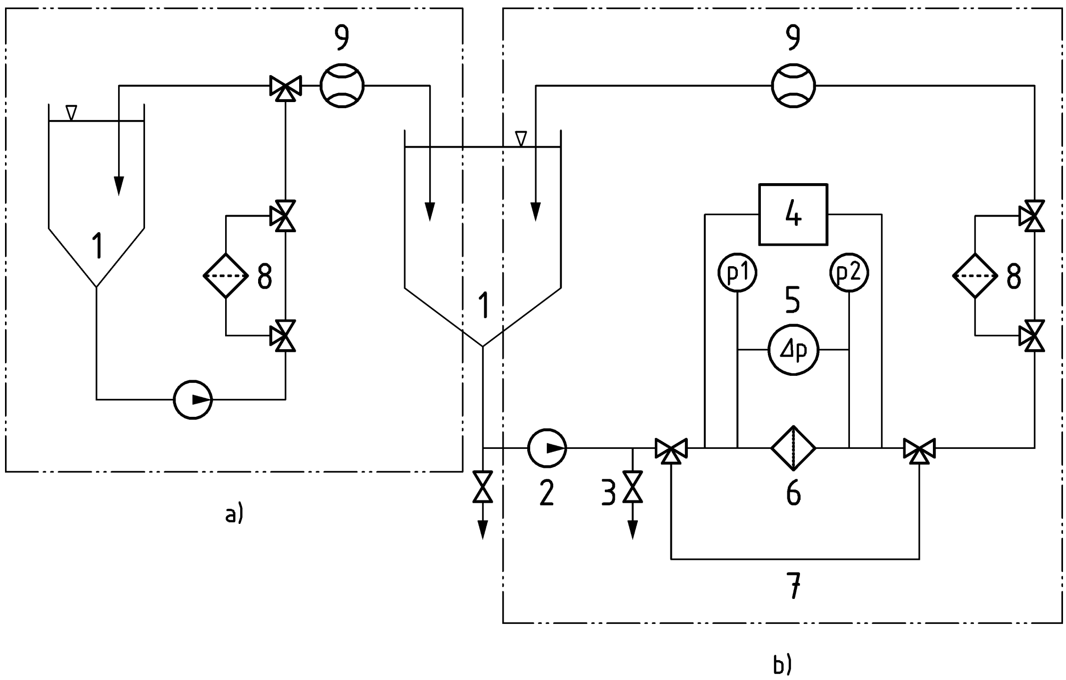
The performances of the filter to be tested are determined by measuring its hydraulic and separation characteristics when it is subjected to the variable flow rate curves (according to Annex A or as specified by the manufacturer); this flow rate shall be, at the start of the test, the filtration system's nominal flow rate specified by the manufacturer.

This test involves the recycling of the contaminant, which is not retained by the test filter challenged at a base concentration of 50 mg/l.

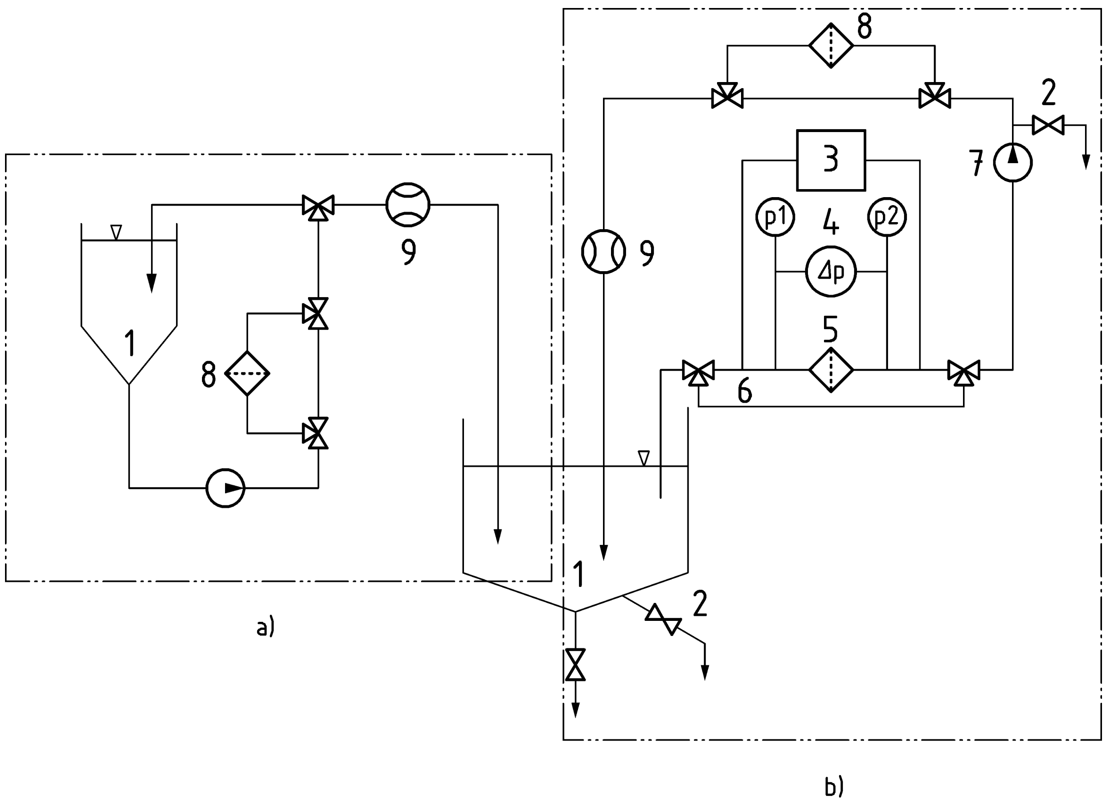
The filtration efficiency is calculated from the automatic particle counts carried out online upstream and downstream of the filter.

7.3.2 Equipment and products

- Test fluid: freshly prepared tap water maintained at (23 ± 3) °C;
- test dust: grade A4 silica dust according to ISO 12103-1 with a size grading of 0 µm to 200 µm;
- precision balance with an accuracy of ± 0,01 g;
- cellulose acetate filter membranes with a median pore diameter (MPD) of 0,8 µm and a diameter of 47 mm;
- 50 mm diameter Petri dishes and lid;
- non-ventilated oven set to (105 ± 2) °C;
- two automatic particle counters (or a counter with two sensors) using the light-extinction principle calibrated with latex spheres according to ISO 21501-3;
- chronometer accurate to the nearest second;
- test bench as according to Figure 11;
- flow meters with an accuracy of ± 5 % of the reading;
- two digital precision pressure gauges with an accuracy class 2,5 according to EN 837-1;
- equipment for the measurement of the test dust concentration defined in EN 872.



a) Pressure filter (at pump discharge)



b) Negative pressure filter (at pump suction)

Key

a) Pressure filter (at pump discharge)

a) contaminant injection circuit
b) filter test circuit
1 contaminant injection and test reservoir
2 test pump
3 sampling tap
4 upstream and downstream particle counter
5 upstream, downstream and differential pressure indicator
6 test filter
7 test filter bypass line
8 clean-up filter
9 flow meter
p pressure

b) Negative pressure filter (at pump suction)

a) contaminant injection circuit
b) filter test circuit
1 contaminant injection and test reservoir
2 sampling tap
3 upstream and downstream particle counter
4 upstream, downstream and differential pressure indicator
5 test filter
6 test filter bypass line
7 test pump
8 clean-up filter
9 flow meter
p pressure

Ensure that the pollutants are kept in suspension during the whole test time.

NOTE 1 The pressure taps are installed as close to the test filters as possible.

NOTE 2 The sampling taps bringing the fluid to the particle counters are installed at a distance as close as possible from the pressure taps in areas, where the fluid flow is turbulent.

Figure 11 — Filtration efficiency and retention capacity test stand schematic

7.3.3 Operating protocol

7.3.3.1 Test preparation

7.3.3.1.1 Calculation of the theoretical test duration

By adopting an initial test concentration of 50 mg/l, calculate the theoretical test duration (T) from the presumed retention capacity of the filter (C_R) and the nominal flow rate (Q_t)

$$T = \frac{C_{\mathrm{R}}}{C_{\mathrm{e}} \cdot Q_{\mathrm{t}}} \qquad (15)$$

where

T is the minimum theoretical test duration expressed in min;

C_{e} is the test concentration expressed in mg/l;

C_{R} is the presumed retention capacity of the filter expressed in mg;

Q_{t} is the nominal flow rate expressed in l/min [Q_{t} (l/min) = 16,66 . Q_{t} (m^3/h)]

If the retention capacity of the test filter is not known, a prior clogging test is recommended according to the following protocol:

The test protocol consists in circulating the fluid through the filter at the nominal flow rate of the filter for the test and in manually injecting the contaminant into the test container in increments of 100 mg until the end of test criterion specified in 7.3.3.3 (filtration unit test) is reached.

7.3.3.1.2 Calculation of the characteristics of injection circuit

The injection conditions are calculated from the pump's initial test flow rate and are maintained throughout the entire test.

a) Based on an injection flow rate of 0,166l/min, calculate the volume of injection suspension to be prepared in the injection circuit taking a margin of 20 %.

$$V_{\mathrm{i}} = 1{,}2\ Q_{\mathrm{i}} \,.\, T = 0{,}2 \,.\, T \qquad (16)$$

where

V_{i} is the volume of injection suspension expressed in l;

Q_{i} is the injection flow rate expressed in l/min;

T is the theoretical test duration expressed in min

b) based on the initial test flow rate (Q_t), calculate the injection concentration (C_{i}) corresponding to a test concentration (C_e) of 50 mg/l and an injection flow rate (Q_i) of 0,166 l/min as follows:

$$C_{\mathrm{i}} = \frac{Q_{\mathrm{t}} \cdot C_{\mathrm{e}}}{Q_{\mathrm{i}}} \qquad (17)$$

where

C_{i} is the injection concentration in mg/l;

Q_t is the test flow rate in l/min [Q_t (l/min) = 16,66 . Q_t (m^3/h)];

C_e is the test concentration in mg/l;

Q_i is the injection flow rate in l/min

c) calculation of the pollutant mass mi to be introduced in the injection circuit:

$$m_i = C_i \cdot V_i \tag{18}$$

where

m_i pollutant mass in mg;

C_i concentration in mg/l;

V_i water volume of the injection circuit in l

7.3.3.2 Filter test circuit preparation and filter conditioning

a) When the filter medium is granular in nature, backwash it under the conditions specified by the manufacturer and empty the filter from its water.

This operation should be carried out on a different installation from the test bench to avoid contaminating it with the residue from washing the material.

b) After making sure by means of a thorough visual inspection that the test circuit is clean, fill the test bench with a volume V (in l) of clean water equal to:

$$V = 10 \,.\, Q + V_{\text{Filter}} \tag{19}$$

where

Q is the nominal flow rate in m^3/h;

V_{Filter} is the volume of filter in l

NOTE In the case of filter by suction, the cleaned water volume is imposed by the test filter and may be much greater.

c) Set up the filtration unit to be tested and operate it for about 10 min to allow the filter body to fill and the filter medium to become wet.

d) Turn on the test circuit's pollution control filter and circulate the fluid through it until the particulate contamination level reaches less than 9,700 particles > 5 µm/100 ml or 1,700 particles > 15 µm/100 ml).

e) Clean the injection circuit by circulating the fluid through the clean-up filter until its contaminant concentration is less than 0,5 % of the calculated injection concentration C_i according to EN 872.

f) Prepare the injection circuit to achieve the characteristics calculated in 7.3.3.1 (test preparation). The mass of the test dust shall be measured with an accuracy of 10 mg after having been heated at (105 ± 2) °C and cooled in the dryer as follows:

1) Preparation:

i) Bring the temperature in the oven up to 105 °C;

ii) Put the pollutant in a container whose dimensions allow it to be spread sufficiently (layer thickness less than 1/4 of main diameter of the container);

iii) Put it in the oven for 60 min;

2) Check humidity is sufficiently removed:

i) Take a sample of pollutant and weigh it;

ii) Put the sample back in the oven away from the rest of the pollutant for 15 min;

iii) Take the sample out of the oven, and weight it again;

iv) If the loss of weight is equal or less than 2 %, the pollutant is sufficiently dried.

g) If the loss of weight is more than 2 %, put the pollutant in the oven for another 15 min, and go back to step 1. Add the pollutant in the injection tank making sure the pollutant does not deposit on the wall of the tank and let the injection circuit circulate on a loop during 5 min to homogenize.

7.3.3.3 Test of the filter or filtration unit

a) When the initial cleanliness level specified in 7.3.3.2 d) is reached, turn off the clean-up filter and after 3 min of stabilization, record the values of the flow rate, the upstream pressure and the differential pressure ($\Delta \rho$) at the terminals of the test filter and the water temperature.

b) Open the sampling taps upstream and downstream of the filter and turn on the particle counters. Programme the counters for 90 s cycles and count the particles for the first 60 s at the following sizes: 20 µm, 30 µm, 40 µm, 45 µm, 50 µm, 60 µm, 70 µm, 80 µm.

Other smaller or higher counting sizes may be chosen depending on the filtration rating of the filter so that the efficiencies measured cover the 80 % efficiency threshold.

c) Start the chronometer and the injection pump and adjust the injection flow rate to (0,166 ± 0,001) l/min.

d) Record the test flow rate (Q_t), the injection flow rate (Q_i), the temperature, the differential pressure (Δp) at the terminals of the filter and the number of particles counted upstream and downstream of the filter until the differential pressure is equal to the one corresponding to the limit cleaning value at the same frequency of the particle counting in point b).

In the absence of any specification, the maximum differential pressure is fixed at 70 kPa (0,7 bar) above the filter's initial pressure measured in 7.3.3.3 a) and/or the end of test flow rate is fixed at 30 % of the flow rate measured at the start of the test.

e) When this end of test value is reached, record the end of test time (T_F) and the water temperature.

f) Stop the injection pump. Bypass the test filter and circulate the fluid in the test system for about 3 min.

g) Measure the volume of fluid in the test system V_F. Take a sample of test fluid upstream the test filter to measure its concentration of contaminant. Label it C_F.

h) Stop the test pump and remove the test filter.

i) Take a sample from the injection circuit to measure the injection concentration C_i according to EN 872.

NOTE The final volume in the test circuit can also be determined according to the following:

$$V_F = V_0 + Q_i \cdot T_F \tag{20}$$

where

V_F final water volume in the test circuit in l;

V_0 initial water volume in the test circuit in l;

Q_i injection flow rate of pollutant in l/min;

T_F time of the test in min

j) Stop the circulation pump of the contaminant injection system.

k) If necessary, drain and clean the test and injection circuits thoroughly.

7.3.4 Calculations

7.3.4.1 Filtration efficiency

a) Calculate the instantaneous efficiency percentage ($Ed\%$) of the filter from the number of particles counted in 7.3.3.3 upstream (Nd_e) and downstream (Nd_s) of the test filter:

$$Ed\% = \frac{100\,(Nd_e - Nd_s)}{Nd_e} \tag{21}$$

where

$Ed\%$ is the efficiency percentage in %;

Nd_e is the number of particles greater than or equal to size d present upstream of the filter;

Nd_s is the number of particles greater than or equal to size d present downstream of the filter

b) Calculate the average number of particles counted upstream and downstream of the test filter throughout the test and calculate the average filtration efficiency of the filter.

7.3.4.2 Retention capacity

7.3.4.2.1 Contaminant injected mass

Calculate the mass of contaminant injected upstream the test filter:

$$M_i = \frac{Q_i \cdot C_i \cdot T_F}{60} \tag{22}$$

where

M_i is the mass of contaminant injected upstream in g;

Q_i is the injection flow rate expressed in l/h;

C_i is the concentration of injection circuit expressed in g/l;

T_F is the total test time in min

7.3.4.2.2 Contaminant non-retained mass

Calculate the mass of contaminant injected in the test system but not retained by the test filter:

$$M_{NR} = V_F \, . \, C_F \qquad (23)$$

where

V_F is the volume of fluid in the test system at the end of the test in l;

C_F is the final concentration of the contaminant in the fluid at the end of the test in mg/l

7.3.4.2.3 Retention capacity

Calculate the retention capacity of the filter at the stated differential pressure Δp ($C_{R\Delta p}$) at the limit cleaning value or the flow rate at the limit cleaning value by substracting to the mass of contaminant injected in the test system the mass of contaminant not retained by the test filter:

$$C_{R\Delta p} = M_i - M_{NR} \qquad (24)$$

where

M_{NR} is the non-retained mass in g;

M_i is the mass of contaminant injected upstream in g

7.3.5 Expression and presentation of results

7.3.5.1 Curves

Plot the following curves:

a) Evolution of the differential pressure at the terminals of the filter and the test flow rate as a function of time and of the mass of injected contaminant.

NOTE If another criteria is used as limit cleaning value for the final user, the evolution of this criteria will be plotted a curve with the time and pollution mass injected

b) Evolution of the flow rate as a function of differential pressure.

c) Average filtration efficiency measured throughout the entire test for different particle sizes as a function of time or of the mass of injected contaminant and complete Table 1 [depending on the counting sizes decided in 7.3.3.3 b)].

Table 1 — Average efficiencies measured

Particle size (µm)	≥ 20	≥ 30	≥ 40	≥ 45	≥ 50	≥ 60	≥ 70	≥ 80
Filtration efficiency E (%)								

7.3.5.2 Filter characteristics

Record the values of the following characteristics of the filter tested:

a) the initial test flow rate and the final test flow rate in m^3/h, to the nearest 0,5 m^3/h;

b) the average efficiency of the filter measured at the size 45 µm, E45 = XX % the average Filtration Rating of the filter S (µm) at 80 % efficiency, S80 = YY µm;

c) the retention capacity of the filter at the final differential pressure at the limit cleaning value or the flow rate at the limit cleaning value $\Delta\rho$: $C_{\mathrm{R\Delta p}}$ = ZZ g.

7.3.5.3 Test report

The report shall include at least the following information:

— laboratory references;

— references and characteristics of the tested filter/pump unit;

— operating conditions;

— test results (flow rate, differential pressure, efficiency, capacity);

— characteristic curves specified in 7.3.5.1;

— average filtration efficiency at 45 µm (E45);

— average filtration rating at 80 % of efficiency (S80); and

— retention capacity at the differential pressure or flow rate at the cleaning limit value.

— pump curve equation used in the test performed.

8 Instructions and operation

8.1 General principles

The person responsible for placing the filter or filtration unit on the market shall supply an installation and operating manual, safety instructions specific to each piece of equipment, and if appropriate, a maintenance guide (see 8.3 to 8.4).

All of these documents shall bear the following indication: “Please read the instruction manual carefully and keep it for future reference” or the following safety graphical symbol.

Figure 12 — Safety graphical symbol EN ISO 7010:2012, M002, Refer to instruction manual/booklet

All these documents shall include the identification elements of the equipment to which they refer:

— the name and contact information of the person responsible for placing the product on the market (manufacturer or importer) or the distributor;

— a telephone number, where the consumer may obtain additional explanations, if necessary;

— the name and reference of the model.

The instructions and tips shall be:

— legible;

— clear;

— comprehensible to the buyer/user and;

— written in the language of that country, where the filter is sold.

When the manuals and guides contain several pages, they shall be in the form of a document with numbered pages.

For better comprehension, the use of illustrations is recommended. Illustrations shall be placed such that they can be seen while the text referring to them is being read.

The visuals shall not contradict the requirements included in this document.

The prohibitions, cautions and warnings shall be according to ISO 3864-2.

National legislation should also be considered.

8.2 Point-of-purchase information

In order to allow the buyer to make a choice, the following information shall be available at the point-of-purchase and shall indicate at least:

a) voltage, frequency and input power for electric components (if needed),

b) type of filter medium,

1) the specification of the media according to 4.3 shall be accessible to the user, either for the first installation as well as for further replacements;

c) turbidity reduction efficiency *TBR* (%);

d) retained mass in g (dp20 test);

e) retention capacity ($C_{R\Delta p}$ expressed in g of ISO CTD), only if this optional test was carried out according to 7.3;

f) filtration rating at 80 % of efficiency and the average filtration efficiency at 45 µm, only if this optional test was carried out according to 7.3;

g) manufacturer's specification for the limit cleaning value;

h) filter or filtration unit nominal flow rate (in m^3/h to the nearest 0,5 m^3/h);

i) characteristics of the fittings.

8.3 User's manual

8.3.1 Installation

The installation shall contain all of the information required for correct and complete installation, including in particular the following, if appropriate:

a) the list of all parts and the description of the installation phases in chronological order;

b) the list of tools necessary for the assembly;

c) the installation recommendations (including the permanently accessibility of the filter and specifying the media to be used).

8.3.2 Operation

The operating manual shall contain all of the information required for correct and complete operation, including in particular the following if appropriate:

a) the recommendations on winterizing and long-term-storage;

b) the recommendations for cleaning/backwashing according to the criteria defined by the manufacturer (limit cleaning value): "*A weekly check is recommended for backwashing or cleaning*" (see 4.7);

c) the following recommendations for filtration:

1) "It is essential to check that the suction openings are not obstructed";

2) "It is advisable to stop the filtration during maintenance operations on the filtration system";

3) "Regularly monitor the filter clogging level";

d) maintenance advice (see 8.4);

e) minimum daily filtration operating time.

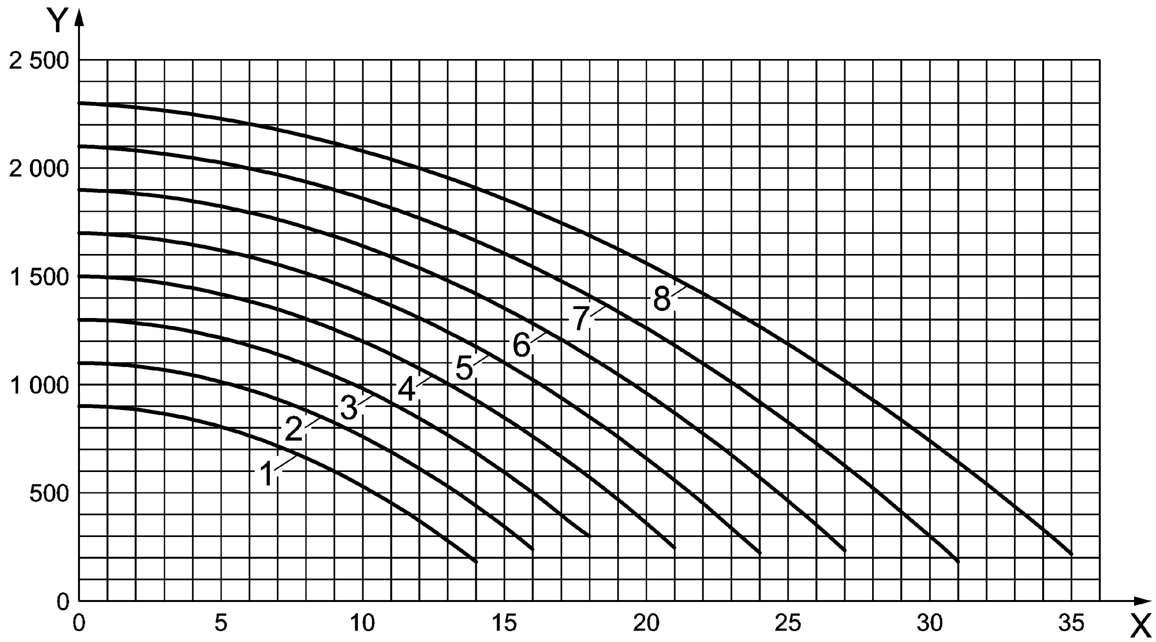
8.4 Maintenance advice

The following recommendation shall appear on the name plate and/or on the technical data sheet and/or in manual: “It is essential to change any damaged element or set of elements as soon as possible. Use only parts approved by the person responsible for placing the product on the market”.

All filters and filter media shall be inspected regularly to ensure that there is not a build-up of detritus thus preventing good filtration. The disposal of any used filter media should also be in accordance with applicable regulations/legislation.

Annex A
(informative)

Harmonized pump curves for the filtration efficiency and retention capacity tests



Key

X test flow rate

Y pressure

1-8 curve no. (see Table A.1)

Figure A.1 — Harmonized pump curves for the filtration efficiency and retention capacity tests

Table A.1 — Calculation of harmonized pump curves

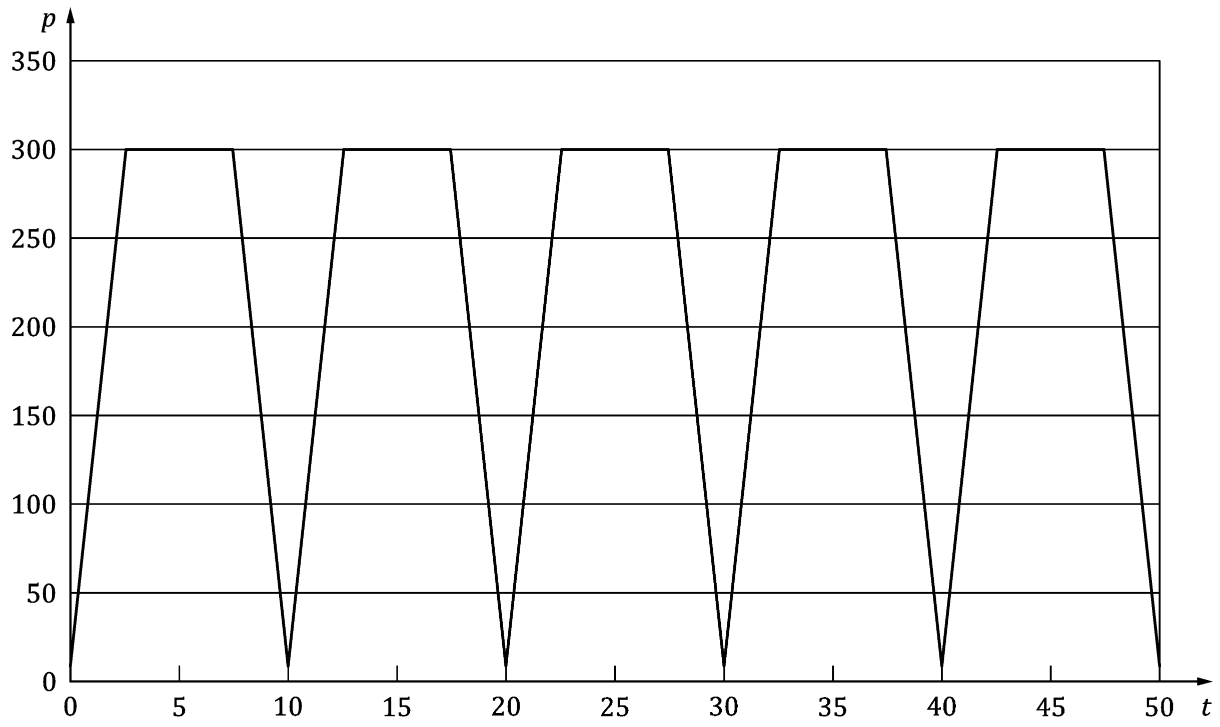
Curve no. (see Figure A.1)	Test flow rate m³/h	Theoretic curve	Formula
1	6,0 to 8,0	1/3 harmonized pump curve	$\rho = -3,6 \cdot Q^2 - 1 \cdot Q + 900$
2	8,0 to 10,0	0,5 harmonized pump curve	$\rho = -3,3 \cdot Q^2 - 1 \cdot Q + 1\,100$
3	10,0 to 12,0	0,75 harmonized pump curve	$\rho = -3 \cdot Q^2 - 2 \cdot Q + 1\,300$
4	12,0 to 14,0	1 harmonized pump curve	$\rho = -2,7 \cdot Q^2 - 3 \cdot Q + 1\,500$
5	14,0 to 18,0	1,5 harmonized pump curve	$\rho = -2,4 \cdot Q^2 - 4 \cdot Q + 1\,700$
6	18,0 to 22,0	2 harmonized pump curve	$\rho = -2,1 \cdot Q^2 - 5 \cdot Q + 1\,900$
7	22,0 to 30,0	2,5 harmonized pump curve	$\rho = -1,8 \cdot Q^2 - 6 \cdot Q + 2\,100$
8	30,0 to 35,0	3 harmonized pump curve	$\rho = -1,5 \cdot Q^2 - 7 \cdot Q + 2\,300$

Annex B
(informative)

Example of test report verifying the resistance to fatigue caused by cyclic pressure or negative pressure variations

Table B.1 — Example of test report

Testing laboratory:	**Test date:**	**Operator:**
Test product code		
Manufacturer:		
Reference no.:		
Operating conditions (see pressure cycle curve in Figure B.1)		
Test fluid		
Temperature (°C)		
Upstream pressure at the start of test (kPa) Upstream pressure at the end of test (kPa)		
Number of cycles specified	Number of cycles applied	
Frequency of cycles		
Observations		
Breakage (Y/N)	**Location**	



Key

ρ upstream in kPa

t time in s

Figure B.1 — Example of a pressure cycle applied upstream of the filter body

Annex C
(informative)

Environmental aspects

Every product has an impact on the environment during all stages of its life-cycle, e.g. extraction of resources, acquisition of raw materials, production, testing, distribution, use (application), reuse, end-of-life treatment, including final disposal. These impacts range from slight to significant; they can be short-term or long-term; and they occur at global, regional or local level. Provisions in product standards have an influence on environmental impacts of products.

The need to reduce the potential adverse impacts on the environment of a product that can occur during all stages of its life is recognized around the world. The potential environmental impacts of products can be reduced by taking into account environmental issues in product standards.

During the life-cycle of a given product, different environmental aspects can be determined. The aim is to promote a reduction of potential adverse environmental impacts caused by products.

NOTE For information, an environmental checklist is given in Table C.1. The purpose of the environmental checklist is to explain whether the standard covers relevant product environmental aspects and, if so, how they are dealt with in the standard.

By no means shall these environmental aspects interfere with the basic health and safety requirements in this standard. In any case the requirement of this standard prevails any environmental aspect that might be related to this product.

The following environmental aspects should be considered.

a) Materials should be selected to optimize product durability and lifetime and consideration should be made to avoiding the selection of rare or hazardous materials.

b) Consideration should be made to using recycled or reused materials, and to the selection of materials which can then be subsequently recycled.

c) The possibility of marking components to aid to their sorting for disposal/recycling at end of life should also be reviewed.

d) Packaging design should consider using recycled materials, and materials that need little energy for their manufacture, and should minimize waste.

e) Packaging design should consider subsequent reuse and recycling.

f) The size and weight of packaging should be minimized while protecting the products to minimize waste through damage. Packaging should be designed to optimize capacity of transportation vehicles while facilitating safe loading and unloading.

g) Test materials should be used and disposed properly, according to the manufacturer’s instructions and to the enforced law in respect of environmental protection.

h) Test facility, test equipment and tools shall be designed to minimize the risk of leak into the environment.

i) Maximum use should be made of high efficiency motors, lighting and displays.

j) The design should facilitate the manufacturing of the product and packaging using tools which minimize the generation of noise and vibration;

k) In case of treatment with chlorine or bromine, the use of a product based on sodium thiosulfate pentahydrate or any equivalent products, as specified in EN 16038, can be used to remove the excess halogen to reduce the environmental impacts (where applicable).

Table C.1 — Environmental Checklist

Environmental Issue	Stages of the life cycle										All stages
	Acquisition		Production		Use			End-of-Life			
	Raw materials and energy	Pre-manufactured materials and components	Production	Packaging	Use	Maintenance and repair	Use of additional products	Reuse/ Material and Energy Recovery	Incineration without energy recovery	Final disposal	Transportation
Inputs											
Materials											
Water											
Energy											
Land											
Outputs											
Emissions to air											
Discharges to water											
Discharges to soil											
Waste											
Noise, vibration, radiation, heat											
Other relevant aspects											
Risk to the environment from accidents or unintended use											
Customer information											
Comments:											

NOTE 1 The stage of packaging refers to the primary packaging of the manufactured product. Secondary or tertiary packaging for transportation, occurring at some or all stages of the life cycle, is included in the stage of transportation.

NOTE 2 Transportation can be dealt with as being a part of all stages (see checklist) or as separate sub-stage. To accommodate specific issues relating to product transportation and packaging, new columns can be included and/or comments can be added.

Bibliography

[1] EN 13443-2:2005+A1:2007, *Water conditioning equipment inside buildings — Mechanical filters — Part 2: Particle rating 1 µm to less than 80 µm — Requirements for performance, safety and testing*

[2] EN 15288 (all parts), *Swimming pools*

[3] EN 16038, *Chemicals used for treatment of water for swimming pools — Sodium hydrogen sulfate*

[4] EN 16582-2, *Domestic swimming pools — Part 2: Specific requirements including safety and test methods for inground pools*

[5] EN 16582-3, *Domestic swimming pools — Part 3: Specific requirements including safety and test methods for aboveground pools*

[6] EUSA — Technical paper domestic swimming pool filtration

[7] AC P90-324, *Private swimming pools for family use — Filtration unit*

[8] AC P90-325, *Private swimming pools for family use — Water network*

[9] AC P90-326, *Private swimming pools for family use — Pool fittings*

[10] EN 15797, *Chemicals used for the treatment of swimming pool water — Iron based coagulants*

[11] EN 15798, *Products used for the treatment of swimming pool water — Filter media*

[12] EN 15799, *Products used for treatment of swimming pool water — Powdered activated carbon*

[13] EN 12901, *Products used for treatment of water intended for human consumption — Inorganic supporting and filtering materials — Definitions*

[14] EN 12903, *Products used for the treatment of water intended for human consumption — Powdered activated carbon*

[15] EN 71-8, *Safety of toys — Part 8: Activity toys for domestic use*

[16] EN 16380, *Chemicals used for treatment of swimming pool water — Potassium peroxomonosulfate*

[17] EN 16381, *Chemicals used for treatment of swimming pool water — Sodium peroxodisulfate*

[18] EN 16399, *Chemicals used for treatment of swimming pool water — Sodium thiosulfate*

[19] EN 16400, *Chemicals used for treatment of swimming pool water — Hydrogen peroxide*

[20] EN 16401, *Chemicals used for treatment of swimming pool water — Sodium chloride used for electrochlorinator systems*

[21] EN 16713–2, *Domestic swimming pools — Water systems — Part 2: Circulation systems — Requirements and test methods*

[22] EN 16713–3, *Domestic swimming pools — Water systems — Part 3: Treatment — Requirements*

[23] EN 16582-1, *Domestic swimming pools — Part 1: General requirements including safety and test methods*

This page deliberately left blank

This page deliberately left blank

British Standards Institution (BSI)

BSI is the national body responsible for preparing British Standards and other standards-related publications, information and services.

BSI is incorporated by Royal Charter. British Standards and other standardization products are published by BSI Standards Limited.

About us

We bring together business, industry, government, consumers, innovators and others to shape their combined experience and expertise into standards -based solutions.

The knowledge embodied in our standards has been carefully assembled in a dependable format and refined through our open consultation process. Organizations of all sizes and across all sectors choose standards to help them achieve their goals.

Information on standards

We can provide you with the knowledge that your organization needs to succeed. Find out more about British Standards by visiting our website at bsigroup.com/standards or contacting our Customer Services team or Knowledge Centre.

Buying standards

You can buy and download PDF versions of BSI publications, including British and adopted European and international standards, through our website at bsigroup.com/shop, where hard copies can also be purchased.

If you need international and foreign standards from other Standards Development Organizations, hard copies can be ordered from our Customer Services team.

Subscriptions

Our range of subscription services are designed to make using standards easier for you. For further information on our subscription products go to bsigroup.com/subscriptions.

With **British Standards Online (BSOL)** you'll have instant access to over 55,000 British and adopted European and international standards from your desktop. It's available 24/7 and is refreshed daily so you'll always be up to date.

You can keep in touch with standards developments and receive substantial discounts on the purchase price of standards, both in single copy and subscription format, by becoming a **BSI Subscribing Member**.

PLUS is an updating service exclusive to BSI Subscribing Members. You will automatically receive the latest hard copy of your standards when they're revised or replaced.

To find out more about becoming a BSI Subscribing Member and the benefits of membership, please visit bsigroup.com/shop.

With a **Multi-User Network Licence (MUNL)** you are able to host standards publications on your intranet. Licences can cover as few or as many users as you wish. With updates supplied as soon as they're available, you can be sure your documentation is current. For further information, email bsmusales@bsigroup.com.

Revisions

Our British Standards and other publications are updated by amendment or revision.

We continually improve the quality of our products and services to benefit your business. If you find an inaccuracy or ambiguity within a British Standard or other BSI publication please inform the Knowledge Centre.

Copyright

Useful Contacts:

Customer Services
Tel: +44 845 086 9001
Email (orders): orders@bsigroup.com
Email (enquiries): cservices@bsigroup.com

Subscriptions
Tel: +44 845 086 9001
Email: subscriptions@bsigroup.com

Knowledge Centre
Tel: +44 20 8996 7004
Email: knowledgecentre@bsigroup.com

Copyright & Licensing
Tel: +44 20 8996 7070
Email: copyright@bsigroup.com

BSI Group Headquarters

389 Chiswick High Road London W4 4AL UK