
**Sampling and test method for
cleanable filter media taken from
filters of systems in operation**

*Échantillonnage et méthode d'essai pour médias filtrants
décolmatables prélevés sur des filtres de systèmes en exploitation*

STANDARDSISO.COM : Click to view the full PDF of ISO 22031:2021



STANDARDSISO.COM : Click to view the full PDF of ISO 22031:2021



COPYRIGHT PROTECTED DOCUMENT

© ISO 2021

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

| | Page |
|--|-----------|
| Foreword | iv |
| Introduction | v |
| 1 Scope | 1 |
| 2 Normative references | 1 |
| 3 Terms and definitions | 1 |
| 4 Sampling of a representative filter element | 2 |
| 4.1 General | 2 |
| 4.2 Selection of the sampling block in the system | 3 |
| 4.2.1 Sampling block | 3 |
| 4.2.2 Number of filter elements to be sampled | 5 |
| 4.2.3 Sampling time and interval | 5 |
| 4.3 Procedure for sampling | 5 |
| 4.3.1 General | 5 |
| 4.3.2 Preparation | 5 |
| 4.3.3 Sampling of filter element | 5 |
| 4.3.4 Installation of new fabric filters | 6 |
| 4.3.5 Transportation of sampled filter elements to the test lab | 6 |
| 5 Test method for the sampled filter fabric | 6 |
| 5.1 General | 6 |
| 5.2 Appearance inspection | 7 |
| 5.3 Photography | 7 |
| 5.4 Cutting out of the test specimen | 7 |
| 5.5 Testing | 7 |
| 5.5.1 General | 7 |
| 5.5.2 Tensile strength | 7 |
| 5.5.3 Elongation ratio | 7 |
| 5.5.4 Air permeability | 8 |
| 5.5.5 Observation with a microscope | 8 |
| 5.5.6 Optional characteristics for measurement | 8 |
| 5.6 Handling of the sampled filter after the test | 8 |
| 6 Precautions for handling samples | 9 |
| 7 Test report | 10 |
| Annex A (informative) Analysing filter media damage through fault tree analysis (FTA) | 11 |
| Annex B (informative) Example of test report | 14 |
| Annex C (informative) Example of test results | 18 |
| Bibliography | 22 |

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).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of 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 www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 142, *Cleaning equipment for air and other gases*.

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.

Introduction

The main purpose of using dust collector systems is to remove dust particles from dirty gases. The dry type filtering dust collectors, known as bag filters, are one of the most widespread industrial dust collectors and are used in applications such as municipal garbage incinerators, coal fired boilers, iron making, cement factories, power plants, etc. Especially, in municipal garbage incinerators, bag filters have been used frequently to overcome dioxin emission^{[1],[2]}.

Since filter media are used under various gas and dust conditions for a long time, their physical and chemical properties change (deteriorate) with operating time due to various causes^{[3]-[12]}. The important filter characteristics such as collection performance and residual pressure drop change with the operation period. Since users of bag filter systems have usually evaluated the parameters associated with the change in the filter properties with their own methods, the results obtained were not easily compared with each other. For this reason, the establishment of a standard for operation, management, and maintenance of filter systems is important to allow prediction of the timing of replacement and/or service life time of filter media.

Changes in the physical and chemical properties of the filter medium, i.e., physical and chemical degradation are caused by many factors, such as heat, particle accumulation, reaction with corrosive gases and deposited particles, and mechanical reasons like clogged weave openings and increasing size of weave openings, the combination of those factors and so on. The filter medium damage can be analysed through the fault tree analysis in [Annex A](#). Clogged weave openings reduce the permeability of the filter medium; and increasing the size of weave openings lessens the collection performance of the filter medium. The reaction with corrosive gases and deposited particles changes properties of the filter fibre material itself and decreases the tensile strength, tenacity, flexibility of the filter medium and so on. These changes cause mostly adverse effects to the filter medium. This can result in the breakage of filter media and leakage of dust to the atmosphere.

Therefore, since it is important to evaluate the property changes of filter media in order to predict the timing of replacement and/or service life time, ISO 16891, which specifies test methods for evaluating degradation of tensile stress of cleanable filter media, has been published. However, test methods for other evaluation parameters such as permeability, collection efficiency, fibre diameter of used filter media, mass and size distribution of deposited particles, have not yet been specified.

Industrial bag filter systems, in general, handle large amounts of dirty gas so that a system with a large number of filter elements in parallel is needed to remove the dust. The degree of degradation of filter properties depends on the location of the filter in the system because the dirty gas usually enters the system in an irregular flow pattern. Furthermore, the method used for sampling and storage of the used filter, and the preparation method of the test specimen should be defined. By standardizing these test methods, it is possible to accurately assess the deterioration of individual filter media.

This document provides a standard method for sampling filter elements from a dust collector system in operation, and a test method for monitoring sampled filter elements and the system through measurement of basic filter properties.

STANDARDSISO.COM : Click to view the full PDF of ISO 22031:2021

Sampling and test method for cleanable filter media taken from filters of systems in operation

1 Scope

This document specifies a method for sampling fabric filter medium from a filter system in operation, and a test method for evaluating the degradation of the sampled filter medium. It applies to both woven and nonwoven fabric filter media.

This document specifies a method for removing used filter medium from a dry-type filtering dust collector, a method for removing dust from the sampled filter medium as part of preparation for testing, and measurement parameters for the test specimen. The number of filter elements to be sampled, their positions in the blocks of filter elements in the dust collector, the position and the size of the test specimens to be cut out from the filter element, measurement parameters and their test methods are also specified.

This document also specifies a storage and transportation method for the sampled filter medium that will protect the health of workers and people conducting the tests.

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 9237, *Textiles — Determination of the permeability of fabrics to air*

ISO 16891:2016, *Test methods for evaluating degradation of characteristics of cleanable filter media*

3 Terms and definitions

For the purposes of this document, the following terms and definitions 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 air permeability

gas volume flow rate per unit filtration area at pressure drop of 124,5 Pa

[SOURCE: ISO 16891:2016, 3.2]

3.2 cleanable filter

filter designed to permit the removal of collected dust by application of an appropriate technique

[SOURCE: ISO 29464:2017, 3.2.73, modified — Note 1 to entry has been removed.]

3.3

degradation

change in physical and chemical performance of a filter medium caused by interaction with corrosive gases

[SOURCE: ISO 16891:2016, 3.9]

3.4

elongation

incremental change in length of test specimen determined by tensile test

[SOURCE: ISO 16891:2016, 3.10]

3.5

nonwoven fabric

filter medium manufactured using fabric made from long fibres, bonded together with each other by chemical, mechanical, heat or solvent treatment

[SOURCE: ISO 16891:2016, 3.21]

3.6

tensile strength

value of the maximum load divided by the width of test specimen

[SOURCE: ISO 16891:2016, 3.27]

3.7

woven fabric

filter medium manufactured using a fabric formed by weaving

[SOURCE: ISO 16891:2016, 3.31]

3.8

pulse cleaning

process for removing collected particulate from a filter element by injecting compressed air in short bursts from the *clean side* (3.11) of the filter element

3.9

snap ring

metallic ring-shaped spring mounted at the open end of the filter element

3.10

dirty side

upstream side of the filter element

3.11

clean side

downstream side of the filter element

3.12

retainer

cage

device supporting the filter element as it performs dust collection

4 Sampling of a representative filter element

4.1 General

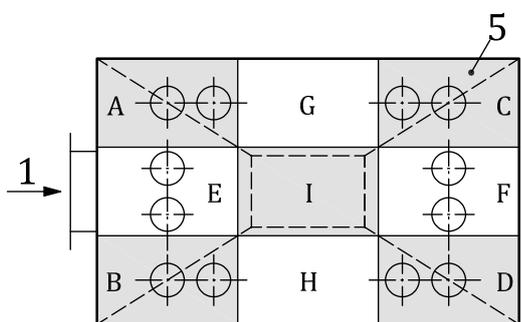
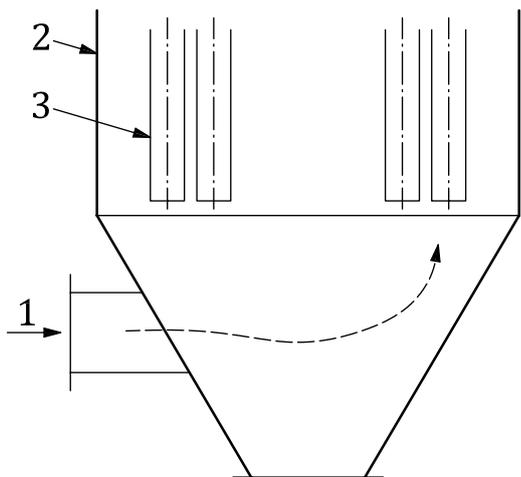
To evaluate or monitor the service life time of filter elements, it is essential to sample a representative filter element, since the degree of degradation of filter properties depends not only on physical causes

but also on the location of the filter in the system. It is difficult in practice to select a representative filter because of the size and structure of the system, arrangement of filter elements, gas flow distribution in the system and so on, which are different for each individual system. Even in the same system, the degree of degradation may vary significantly with the specific position of the element in the filter array. It is often extremely difficult to identify exactly the most deteriorated filter in the system. The best practice approach may be to choose as representative a filter element from the area in the system that is observed to be the most deteriorated.

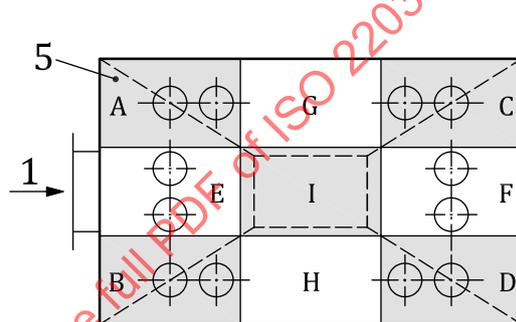
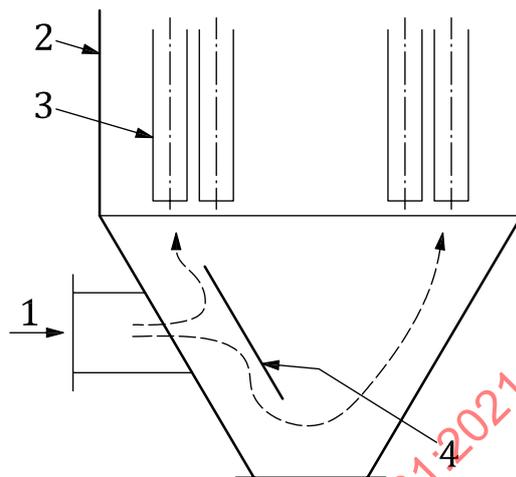
4.2 Selection of the sampling block in the system

4.2.1 Sampling block

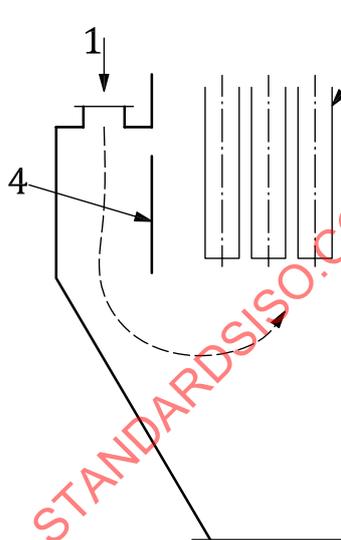
The most serious deterioration is expected to appear in the area where the dirty gas concentrates. The general location of this area depends on whether the bag filter system has a baffle plate at the dirty gas inlet. When the dirty gas flows into the system without a baffle plate, the gas will flow to the opposite side of the system and change the flow direction as shown in [Figure 1 a\)](#) so that the representative filter element is recommended to be sampled from a block either at the centre or at the opposite side of the system from the dirty gas inlet, for instance, block F, C, D. When the system has a baffle plate, the dirty gas flow is divided by the baffle plate and will come together again downstream as shown in [Figure 1 b\)](#). Therefore, the filter element is recommended to be sampled from a block where the gas flow concentrates after it is divided by the baffle plate, for instance, block E or F. Alternatively, the filter element can be sampled from the block identified by a flow analysis to be where the dirty gas concentrates, for instance, block E, I, F for the left-hand side and G, I, H for the right-hand side as shown in [Figure 1 c\)](#) and d).



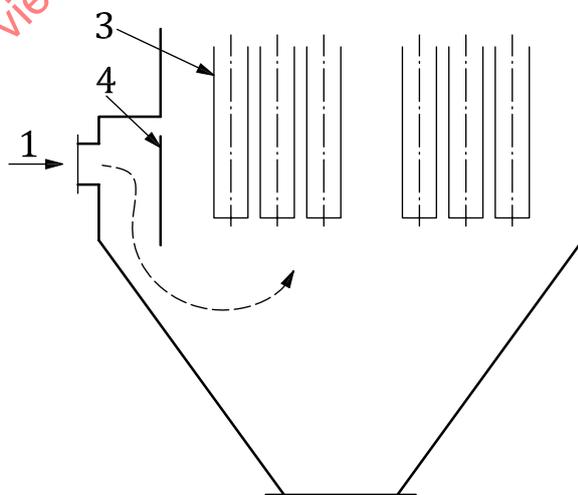
a) Bag filter system without baffle plate



b) Bag filter system with baffle plate



c) Area where dirty gas flow concentrates is already identified by flow analysis etc.



d) Area where dirty gas flow concentrates is already identified by flow analysis etc.

Key

- 1 dirty gas entry
- 2 bag house
- 3 filter element

- 4 baffle plate
- 5 block of filter elements in the bag house (A to I)

Figure 1 — Examples of sampling block

4.2.2 Number of filter elements to be sampled

The number of filter elements to be sampled shall be determined by the number of blocks of filter elements in the bag filter system.

- a) Bag filter with one block: at least one sample.
- b) Bag filter with multiple blocks: at least one filter element per block shall be sampled.

4.2.3 Sampling time and interval

The filter element shall first be sampled around one year after its operation starts. Thereafter, it is preferable to sample at about one-year intervals.

A sample of the unused fabric filter shall be stored as reference to create a baseline for comparison.

Though plants installing a bag filter system usually operate continuously, the facility shall be shut down when sampling the filter media. Therefore, it is preferable to sample the filter element during a routine shut-down period of the facility, such as during periodic inspection and repair.

4.3 Procedure for sampling

4.3.1 General

Sampling of the filter element is carried out by replacing old and installing new filter elements in the sequence described in [4.3.2](#) to [4.3.5](#).

4.3.2 Preparation

- a) Stop the dust laden gas flow to the bag filter system, operate the system for more than 10 min with clean air alone, and repeat pulse cleaning several times to remove dust from the filter element as much as possible.
- b) The flow rate and pressure drop across the filter element designated as a sample shall be measured.
- c) Stop the clean air supply.
- d) Then open the lid on the dirty side of the system and take a picture of the arrangement of the bag filter from the bottom of the system.

4.3.3 Sampling of filter element

- a) Open the lid on the clean side of the system.
- b) Remove the retainer holding the filter element. Then remove the filter element by loosening the snap rings used for fixing the element in place.
- c) Pull down the sampled filter element to the dust bin with a rope while preventing penetration of dust inside the filter medium and the re-entrainment of dust from the filter medium. Depending on the situation, it may be pulled up to the clean side of the system. If this option is chosen, care shall be taken not to contaminate the clean side of the system with dust from the removed filter.

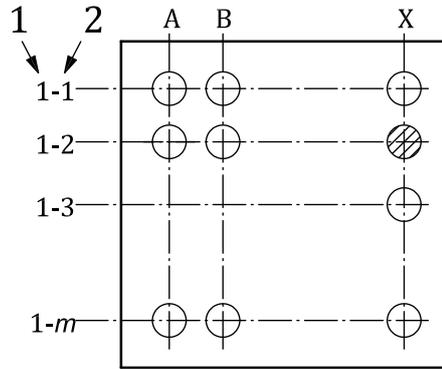
NOTE 1 When filter element can be dropped down softly to the dust bin without a rope, the use of a rope is not necessary.

- d) Measure the mass of the filter element, if possible, and record the value in grams (g) for reference.
- e) Put the sampled filter element into a polyethylene bag, etc. and seal the bag tightly. In order to prevent changes in the properties of the filter, the bag should be kept under vacuum or filled with an inert gas, if possible.

NOTE 2 This is to prevent absorption of moisture and re-entrainment of dust. Hence, it is desirable to put the sampled filter element into a double layer polyethylene bag.

- f) Record on the polyethylene bag details of the position of the sampled filter element in the filter element array, including block number and position within the block. An example of the position of the filter elements in the system is shown in Figure 2 (the hatched filter element location is 1-2-X).

NOTE 3 When a plan of the filter element array is provided, the location of the sampled filter element should be marked on the plan.



Key

- 1 block number in the system
- 2 row number in the block (1 to m)
- X column number in the block (A to X)

Figure 2 — Arrangement plan of fabric elements in the bag

4.3.4 Installation of new fabric filters

Install new filter elements at the same positions in the same blocks as those where the sampled filter elements have been removed.

4.3.5 Transportation of sampled filter elements to the test lab

The sampled filter elements shall be transported by the following process.

- a) The polythene bags containing the sampled filter elements shall be put in a cardboard box not in contact with each other and sealed tightly to prevent re-entrainment of attached dust, etc. In the case of handling, care shall be taken that the dust does not re-entrain.
- b) The sampled filter elements shall be sent by an appropriate means of transport to arrive at the test laboratory within 2 days after sampling.

NOTE Each country has laws and regulations on the handling and transporting hazardous materials and industrial wastes.

5 Test method for the sampled filter fabric

5.1 General

The sampled filter elements shall be selectively tested for the characteristics shown below after negotiation between stakeholders. In the negotiation, consideration should be given to whether or not the filter is damaged, and the degree of damage.

5.2 Appearance inspection

Stretch the filter fabric out on a flat plate, visually examine the damaged site, and measure the damage outline size. The measured value should be recorded.

5.3 Photography

Mark the top (open) and bottom ends of the filter fabric with the filter stretched out; pictures of the filter fabric should be taken from both front and back sides. In addition, if a photograph of the whole of the filter fabric is considered difficult or unnecessary because of space restrictions at the photograph site, or limited presence or absence of damage to the filter, etc., a partial photograph may be allowed.

5.4 Cutting out of the test specimen

Clean the filter fabric carefully in a manner appropriate for the test to be conducted, such as with a vacuum cleaner, air jet, brush or scraper. The dust removed from the filter shall be captured and preserved. Cut out test specimens from the filter that meet the following requirements.

Test samples shall be cut out at three sites designated as “upper”, “medium” and “lower” as shown in [Figure 3](#).

If it is judged that three sites are unnecessary because of limited presence, or absence, of damage on the filter, a sample may be cut out at two sites such as “upper” and “lower”.

The samples shall be cut out where the filter contacts the retainer wire. The test specimen in the longitudinal direction shall be cut so that the contact line of the longitudinal wire is located at the centre of the specimen, and in the case of the lateral test specimen, the lateral contact line is located at the centre. An example of this is shown in [Figure 3](#).

5.5 Testing

5.5.1 General

Measurement of each of the test specimens shown in [Figure 3](#) shall be as described in [5.5.2](#) to [5.5.6](#). In cases where the test is performed on a dusty filter, the attached dust should be brushed away as much as possible while preventing dust from being released to the environment.

5.5.2 Tensile strength

The test shall be performed in accordance with the method specified in ISO 16891:2016, 7.3.

Cut out three test specimens (25 mm × 200 mm) in both longitudinal and lateral directions from the sample, pull each of them at a constant rate (100 mm/min) with a width of 25 mm and a clamp distance of 100 mm, calculate the maximum load (N) and obtain an average value for both sets of measurements. The measured data shall be recorded together with the test method.

5.5.3 Elongation ratio

The test shall be performed in accordance with the cut strip method in the method A specified in ISO 16891:2016, 7.3.

Cut out three test specimens (25 mm × 200 mm) in longitudinal and lateral directions, respectively, from the sample, pull each of them at a constant rate (100 mm/min) with a width of 25 mm and a clamp distance of 100 mm, calculate the elongation ratio (%) and obtain an average value of them. The measured data shall be recorded together with the test method.

5.5.4 Air permeability

The measurement shall be performed both with dust attached on the filter and with the dust removed using a brush, a cleaner, etc. to a level that does not damage the fabric filter.

The test shall be performed according to Frazier type method specified in ISO 9237 or an equivalent method^{[13]-[15]}. Take three test specimens from the sample and obtain their average permeability value at the differential pressure specified in the referenced method. The unit is $(\text{cm}^3/\text{s})/\text{cm}^2$ or $\text{cm}^3/\text{cm}^2/\text{s}$. The measured data shall be recorded together with the test method.

5.5.5 Observation with a microscope

Take enlarged photographs of the dust collecting surface, cross-section and cleaned surface of the filter fabric using an optical microscope, confirm the presence or absence of dust leaks and record the result.

Optionally, take electron microscopic photographs to confirm the diameter and degradation condition of the fibre and record the result.

5.5.6 Optional characteristics for measurement

a) Thickness of the filter medium

Measure the filter thickness at several points in the specimen with an appropriate measuring device such as a dial gauge.

b) Stiffness of the filter medium

c) Cohesiveness of dust particles

d) Size distribution of dust particles

After dispersing the dust particles removed from the filter medium analyse their particle size distribution with a particle size analyser such as a laser scattering instrument.

e) Chemical make-up of dust particles

Measure the chemical components of the dust particles removed from the filter medium with energy dispersive X-ray spectrometry (EDX) or X-ray photoelectron spectroscopy (XPS) etc.

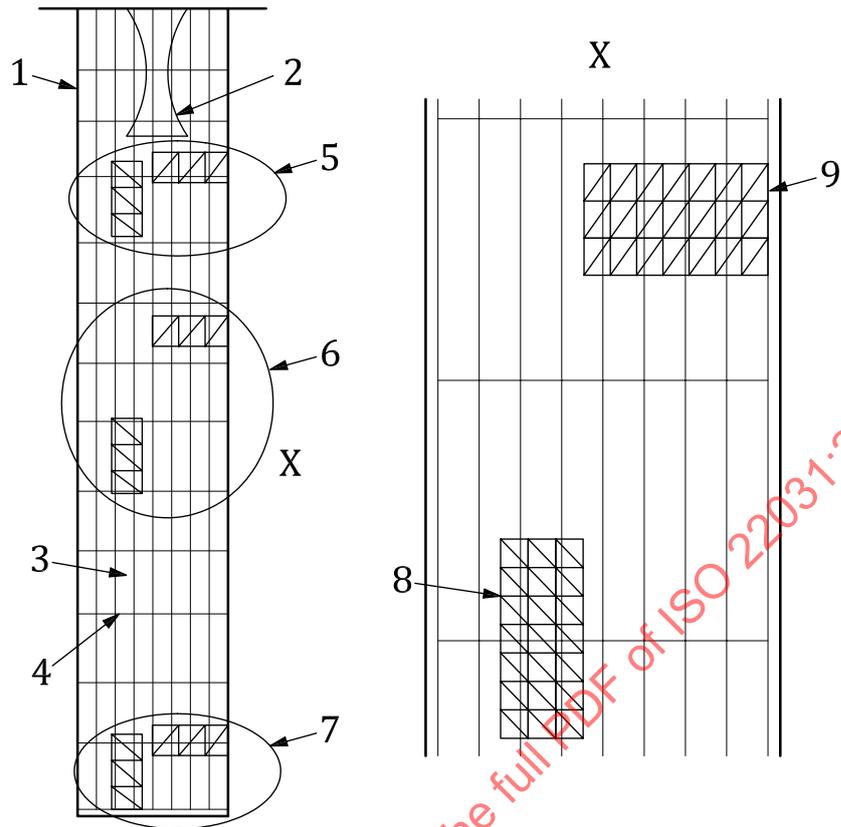
5.6 Handling of the sampled filter after the test

Handling of the sampled filter after the test shall be performed as follows.

a) The sample piece(s) and the separated and removed dust shall be returned to the facility where the filter sample was obtained if possible.

b) In the case where the persons in charge of the test are responsible for disposing of the sample, the sample shall be treated as industrial waste and disposed of in compliance with appropriate local regulations.

NOTE Each country has laws and regulations on the handling and transporting of hazardous materials and industrial wastes.

**Key**

| | | | |
|---|---|---|---------------------------------------|
| 1 | filter medium | 6 | middle part of filter element |
| 2 | Venturi tube | 7 | lower part of filter element |
| 3 | retainer wire, longitudinal direction | 8 | test specimen, longitudinal direction |
| 4 | retainer wire, lateral direction | 9 | test specimen, lateral direction |
| 5 | upper part of filter element below Venturi tube | | |

Figure 3 — Examples of sampling positions for test specimens in the filter element

6 Precautions for handling samples

Precautions for handling and personal protection shall be as follows.

- a) In the case of sampling filter fabric from a bag filter, attention shall be paid to minimizing inhalation of dust.

NOTE Each country has laws and regulations on handling. For example, “Exposure preventive countermeasures to dioxins in works in industrial waste incineration facilities” (Labour Standards Bureau Notification No. 401 of Apr. 25, 2001, Ministry of Health, Labour and Welfare, Japan, Director-General of Labour Standards Bureau)^[1], “Act on Special Measures against Dioxins” (Act No.105 of July 16, 1999, Japan)^[2].

- b) Persons in charge of the test in a laboratory should wear dust-proof clothes and appropriate respiratory protection when cutting out samples, and wear appropriate personal protective equipment (PPE) while conducting the test work.
- c) Places such as laboratories where the test work is conducted shall be equipped as follows.
- 1) An air shower or other barrier should be set up at the entrance. In addition, care shall be taken that dust is not released to the environment.

- 2) A local exhaust ventilation (LEV) system equipped with a high efficiency particulate air (HEPA) filter (ISO 29463-1) should be installed for dust containment. It should be a dedicated cleaner which is not used for any other purpose.

7 Test report

An example of a test report is shown in [Annex B](#), and an example of measurement results summarized in a test report is shown in [Annex C](#). The report shall include the following information.

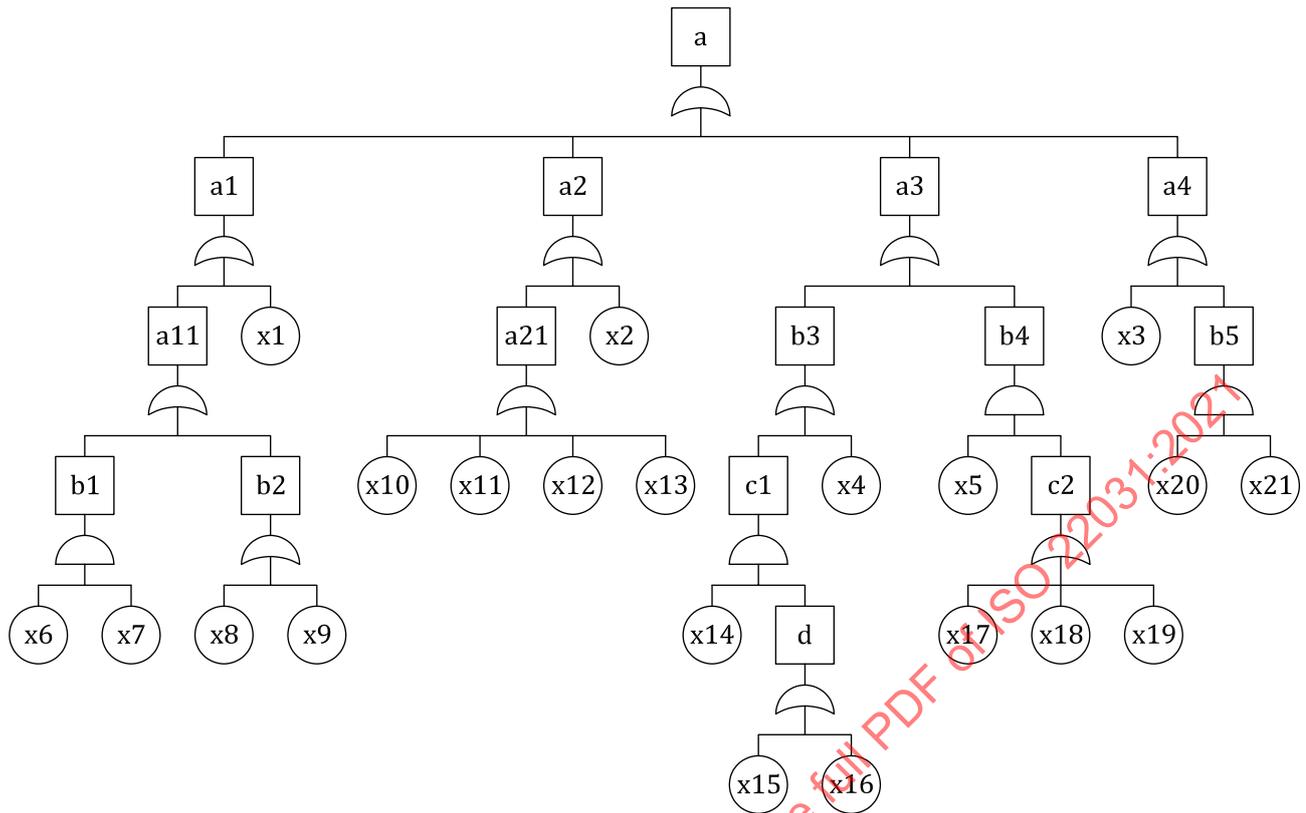
- a) Facility: name of company, address, date of sampling, name of sampling operator.
- b) Bag filter system: type of system, designed capacity of the system, total number of filter elements, number of blocks, number of elements in a block, arrangement of filter elements in the system.
- c) Material and properties of virgin filter medium: name of product (manufacturer, type of fibre, web, scrim, fibre material and diameter), surface processing, area mass, thickness, air permeability, tensile strength in longitudinal and lateral directions, elongation ratio in longitudinal and lateral directions.
- d) Operating conditions of the bag filter System: operating temperature and pressure, gas flow rate (at 273,15 K, 0,101 3 MPa and dry condition), filtration velocity, actual operating time since installation, dust (name, mean size, deviation, components), gas components (CO₂, CO, NO_x, SO_x, HCl, CO, Hg, H₂O, others).
- e) Results of the test:
 - 1) Basic data on the sampled element: location of the element (block number, address), size of the element (diameter, length), date of last installation of the element: appearance (photo image).
 - 2) Dust deposited on the sampled filter element: mass per unit filter area, material and composition.
 - 3) Mean dust size and distribution: mean size, deviation.
 - 4) Environmental conditions during the test: ambient (outdoor) temperature, ambient pressure, relative humidity, weather.
 - 5) Results:
 - i) air permeability (number of measurement points, mean air permeability);
 - ii) thickness (number of measurement points, mean thickness);
 - iii) Tensile strength (tensile rate, mean strength in longitudinal and lateral directions), elongation ratio (mean ratio in longitudinal and lateral directions), others.
- f) Other comments

Annex A (informative)

Analysing filter media damage through fault tree analysis (FTA)

Filter media damage mechanisms are complex and can be caused by many factors. To identify these factors and understand how filter media can fail, FTA is utilized. FTA is a top-down, deductive failure analysis in which an undesired state of a system is analysed using Boolean logic to combine a series of lower-level factors. [Figure A.1](#) shows an FTA for filter media damage.

STANDARDSISO.COM : Click to view the full PDF of ISO 22031:2021



Key

| | | | |
|---|---|---|---|
|  | or |  | and |
|  | top level – damaged filter |  | second level - type of damage |
|  | third level - underlying cause of damage |  | bottom (fourth) level - filter system characteristics leading to the underlying cause of damage |
|  | | | |
| a | filter media damage | b1 | jet airflow erosion |
| a1 | aerodynamic damage | b2 | dusty gas erosion of filter media |
| a2 | mechanical damage | b3 | acid or alkali corrosion |
| a3 | chemical damage | b4 | oxidation and hydrolysis |
| a4 | thermal damage | b5 | too high temperature |
| a11 | aerodynamic damage factors | c1 | acid and alkali substances in gas |
| a21 | mechanical damage factors | c2 | high concentration of O ₂ , and H ₂ O |
| | | d | gas temperature ≤ acid dew point |
| x1 | weak anti-erosion capability | x11 | collision between bag and bag/wall/bag cage |
| x2 | weak resistance to mechanical damage | x12 | scratching during installation |
| x3 | poor heat resistance | x13 | stamping and pressing during bag installation/storage/transportation |
| x4 | weak acid and alkali resistance | x14 | gas containing acid or alkaline substance |
| x5 | weak resistance to oxidation and hydrolysis | x15 | low gas temperature |
| x6 | improper installation of injection pipe | x16 | weak heat preservation of filter box |
| x7 | unprotected pocket for filter media | x17 | large excess air coefficient |
| x8 | high concentration air flow of box inlet | x18 | excess water in the bag filter, usually condensation |

| | | | |
|-----|---|-----|---|
| x9 | uneven airflow distribution between chambers | x19 | flue air leakage |
| x10 | abrasion between bag and bag/bag cage/chamber | x20 | boiler failure leading to high dust temperature |
| | | x21 | cooling measures failure |

Figure A.1 — FTA of filter media damage

STANDARDSISO.COM : Click to view the full PDF of ISO 22031:2021

Annex B (informative)

Example of test report

[Table B.1](#) shows an example of a test report. [Table B.2](#) shows an example of a data sheet for collecting raw data.

Table B.1 — Example of a test report

| 1 - Facility | | | |
|--|------------------------------------|--|----------------------|
| Name of company: | | Date of sampling: | |
| Address: | | Name of sampling operator: | |
| 2 - Bag filter system | | | |
| Type of system: <i>(with or without baffle plate)</i> | | <i>Arrangement of filter elements in the system (figure)</i> | |
| Designed capacity of the system: | (m ³ /h) | | |
| Total number of filter elements: | | | |
| Number of blocks: | | | |
| Number of elements in a block: | | | |
| 3 - Material and properties of virgin filter medium | | | |
| Name of product: | | <i>Appearance (Photograph)</i> | |
| Manufacturer: | | | |
| Type of fibre: | | | |
| Web front side | | | |
| Fibre material: | | | |
| Fibre diameter: | | | |
| Web rear side | | | |
| Fibre material: | | | |
| Fibre diameter: | | | |
| Scrim | | | |
| Fibre material: | | | |
| Fibre diameter: | | | |
| Surface processing: | | | |
| Area mass: | (kg/m ²) | | |
| Thickness: | (mm) | Name of microscope: | |
| Air permeability: | m ³ /(m ² s) | at Δp: (Pa) | |
| Tensile strength in longitudinal direction: | | (N) | (width) mm |
| Tensile strength in lateral direction: | | (N) | (width) mm |
| Elongation ratio in longitudinal direction: | % | Elongation ratio in lateral direction: | % |
| 4 - Operating conditions of the bag filter system | | | |
| Operating temperature: | (K) | Operating pressure: | (MPa) |
| Gas flow rate: | (m ³ /h) | <i>(at 273,15 K to 0,101 3 MPa and dry condition)</i> | |
| Filtration velocity: | (m/s) | Actual operating time since installation: | (months) |
| Dust name: | | Dust concentration: | (kg/m ³) |

Table B.1 (continued)

| | | | | | | |
|---|--------------------------------------|---------------------------|---------------------|------|-------------------|---|
| Dust mean size: | (μm) | | Deviation: | (μm) | | |
| Dust components: | | | | | | |
| Gas components: | CO ₂ : | % | CO: | % | NO _x : | % |
| | SO _x : | % | HCl: | % | Hg: | % |
| | H ₂ O: | % | Others: | % | | |
| 5 - Results of the test | | | | | | |
| 5.1 Basic data on the sampled element | | | | | | |
| Location of the element: | Block N. | | Row: | | Column: | |
| Size of the element: | Diameter: | (mm) | Length: | (mm) | | |
| Date of last installation of the element: | | | | | | |
| 5.2 Dust deposited on the sampled filter element | | | | | | |
| Mass per unit filter area: | (g/m ²) | Material and composition: | | | | |
| Mass before cleaning: | (g/m ²) | Mass after cleaning: | (g/m ²) | | | |
| Analysed by: | <i>(method and name of analyser)</i> | | | | | |
| 5.3 Mean dust size and distribution | | | | | | |
| Mean size: | (μm) | | Deviation: | (μm) | | |
| 5.4 Environmental conditions during the test | | | | | | |
| Ambient temperature: | (K) | Ambient pressure: | (MPa) | | | |
| Relative Humidity: | % | Weather: | | | | |
| 5.5 Results | | | | | | |
| a) Upper part | | | | | | |
| Mean air permeability: | m ³ /(m ² s) | | at Δp: (Pa) | | | |
| Measurement area: | (cm ²) | | | | | |
| Number of measurement points: | | | | | | |
| Mean thickness: | (mm) | | | | | |
| Number of measurement points: | | | | | | |
| Tensile strength (Tensile rate: 100 mm/min): | | | | | | |
| Mean strength in longitudinal direction: | | | | | | |
| (N) | (width) mm | | | | | |
| Mean strength in lateral direction: | | | | | | |
| (N) | (width) mm | | | | | |
| Elongation: | Appearance (photo image) | | | | | |
| Mean in longitudinal direction: | % | | Magnification: | | | |
| Mean in lateral direction: | % | | Name of microscope: | | | |

Table B.1 (continued)

| 5.5 Results | | | | | |
|---|---------------|--------------------------|--|---------------------|--|
| b) Middle part | | | | | |
| Mean air permeability: | $m^3/(m^2 s)$ | at Δp : (Pa) | | | |
| Measurement area: | (cm^2) | Appearance (photo image) | | | |
| Number of measurement points: | | | | | |
| Mean thickness: | (mm) | | | | |
| Number of measurement points: | | | | | |
| Tensile strength (<i>Tensile rate: 100 mm/min</i>): | | | | | |
| Mean strength in longitudinal direction: | | | | | |
| (N) | (width) mm | | | | |
| Mean strength in lateral direction: | | | | | |
| (N) | (width) mm | | | | |
| Elongation: | | | | | |
| Mean in longitudinal direction: | % | | | Magnification: | |
| Mean in lateral direction: | % | | | Name of microscope: | |
| c) Lower part | | | | | |
| Mean air permeability: | $m^3/(m^2 s)$ | at Δp : (Pa) | | | |
| Measurement area: | (cm^2) | Appearance (photo image) | | | |
| Number of measurement points: | | | | | |
| Mean thickness: | (mm) | | | | |
| Number of measurement points: | | | | | |
| Tensile strength (<i>Tensile rate: 100 mm/min</i>): | | | | | |
| Mean strength in longitudinal direction: | | | | | |
| (N) | (width) mm | | | | |
| Mean strength in lateral direction: | | | | | |
| (N) | (width) mm | | | | |
| Elongation: | | | | | |
| Mean in longitudinal direction: | % | | | Magnification: | |
| Mean in lateral direction: | % | | | Name of microscope: | |
| 6 - Other comments | | | | | |

STANDARDSISO.COM: Click to view the full PDF of ISO 22031:2021

Table B.2 — Example of a data sheet for collecting raw data

| Specimen | | Longitudinal direction | | | | Lateral direction | | | |
|----------|------|---|-------------------|--|-------------------------|---|-------------------|--|-------------------------|
| Location | No. | Air permeability [m ³ /(m ² s) at Δp= ----- Pa] | Thickness [mm] | Tensile strength [N/(width)----- mm] | Elongation ratio [%] | Air permeability [m ³ /(m ² s) at Δp= ----- Pa] | Thickness [mm] | Tensile strength [N/(width)----- mm] | Elongation ratio [%] |
| Upper | 1 | | | | | | | | |
| | 2 | | | | | | | | |
| | 3 | | | | | | | | |
| | Mean | | | | | | | | |
| Middle | 4 | | | | | | | | |
| | 5 | | | | | | | | |
| | 6 | | | | | | | | |
| | Mean | | | | | | | | |
| Lower | 7 | | | | | | | | |
| | 8 | | | | | | | | |
| | 9 | | | | | | | | |
| | Mean | | | | | | | | |
| Device | | | | | | | | | |

Annex C (informative)

Example of test results

[Table C.1](#) shows an example of test results. [Table C.2](#) shows an example of a data sheet for collecting raw data that is filled in.

Table C.1 — Example of test results

| 1 - Facility | | | |
|--|--|--|-------------------|
| Name of company: | FP Optimum Inc | Date of sampling: | 14/05/2018 |
| Address: | 123 Long St., Yoville, ND 54321 | Name of sampling operator: | John Marcos |
| 2 - Bag filter system | | | |
| Type of system: <i>(with or without baffle plate)</i> | with baffle plate | | |
| Designed capacity of the system: | 27 000 (m ³ /h) | | |
| Total number of filter elements: | 54 | | |
| Number of blocks: | 9 | | |
| Number of elements in a block: | 6 | | |
| 3 - Material and properties of virgin filter medium | | | |
| Name of product: | PPS | | |
| Manufacturer: | Filterman Ltd. | | |
| Type of fibre: | | | |
| Web front side | | | |
| Fibre material: | PPS | | |
| Fibre diameter: | 15,0 µm | | |
| Web rear side | | | |
| Fibre material: | PPS | | |
| Fibre diameter: | 15,0 µm | | |
| Scrim | | | |
| Fibre material: | PPS | | |
| Fibre diameter: | 15,0 µm | | |
| Surface processing: | NO | | |
| Area mass: | 0,650 (kg/m ²) | Name of microscope: | Hitachi, JSM-5600 |
| Thickness: | 1,8 (mm) | | |
| Air permeability: | 13,85 m ³ /(m ² s) | at Δp: 125 (Pa) | |
| Tensile strength in longitudinal direction: | | 307,5 (N) | 25 (width) mm |
| Tensile strength in lateral direction: | | 997,5 (N) | 25 (width) mm |
| Elongation ratio in longitudinal direction: | 22 % | Elongation ratio in lateral direction: | 42,3 % |