



International
Standard

ISO 16890-3

**Air filters for general ventilation —
Part 3:
Determination of the gravimetric
efficiency and the air flow
resistance versus the mass of test
dust captured**

Filtres à air de ventilation générale —

*Partie 3: Détermination de l'efficacité gravimétrique et de la
résistance à l'écoulement de l'air par rapport à la quantité de
poussière d'essai retenue*

**Second edition
2024-08**

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document 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).

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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*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 195, *Cleaning equipment for air and other gases*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition cancels and replaces the first edition (ISO 16890-3:2016), which has been technically revised.

The main changes are as follows:

- the initial loading step has been revised from 30 g to 60 g throughout the document.

A list of all parts in the ISO 16890 series can be found on the ISO website.

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

Introduction

The effects of particulate matter (PM) on human health have been extensively studied in the past decades. The results are that fine dust can be a serious health hazard, contributing to or even causing respiratory and cardiovascular diseases. For the outdoor environment, the U.S. Environmental Protection Agency (EPA), the World Health Organization (WHO), the European Union, and other national agencies have established acceptable air quality standards according to concentrations of particulate matter classified per their aerodynamic sizes, defined as $PM_{2,5}$ and PM_{10} , and measured according to strict prescriptive methods and sampling times.

Since there is growing interest in relating indoor air quality to outdoors, the ISO 16890 series classifies ventilation filters according to their efficiencies measured with an optical diameter between $0,3 \mu\text{m}$ and $x \mu\text{m}$ and relating the result to historic global average ambient PM concentrations. Although not exactly equivalent to filter performance of national ambient air quality standards at PM, the classification scheme presented in the ISO 16890 series yields a level of correspondence to the effectiveness of the filter for ambient particle concentrations. It is however recognized that the correspondence based on global averages may not be exactly the same at a specific location since local ambient particle concentration may be different than the global average.

The particle size ranges shown in [Table 1](#) are used in the ISO 16890 series for the listed efficiency values.

Table 1 — Optical particle diameter size ranges for the definition of the efficiencies, ePM_x

Efficiency	Size range μm
ePM_{10}	$0,3 \leq x \leq 10$
$ePM_{2,5}$	$0,3 \leq x \leq 2,5$
ePM_1	$0,3 \leq x \leq 1$

Air filters for general ventilation are widely used in heating, ventilation and air-conditioning applications of buildings. In this application, air filters significantly influence the indoor air quality and, hence, the health of people, by reducing the concentration of particulate matter. To enable design engineers and maintenance personnel to choose the correct filter types, there is an interest from international trade and manufacturing for a well-defined, common method of testing and classifying air filters according to their particle efficiencies, especially with respect to the removal of particulate matter. Current regional standards are applying totally different testing and classification methods, which do not allow any comparison with each other, and thus hinder global trade with common products. Additionally, the current industry standards have known limitations by generating results which often are far away from filter performance in service, i.e. overstating the particle removal efficiency of many products. With the ISO 16890 series, a completely new approach for a classification system is adopted, which gives more meaningful results compared to the existing standards.

The ISO 16890 series describes the equipment, materials, technical specifications, requirements, qualifications and procedures to produce the laboratory performance data and efficiency classification based upon the measured fractional efficiency converted into a particulate matter efficiency (ePM) reporting system.

Air filter elements according to the ISO 16890 series are evaluated in the laboratory by their ability to remove aerosol particulate expressed as the efficiency values ePM_1 , $ePM_{2,5}$ and ePM_{10} . The air filter elements can then be classified according to the procedures defined in ISO 16890-1. The particulate removal efficiency of the filter element is measured as a function of the particle size in the range of $0,3 \mu\text{m}$ to $10 \mu\text{m}$ of the unloaded and unconditioned filter element as per the procedures defined in ISO 16890-2. After the initial particulate removal efficiency testing, the air filter element is conditioned according to the procedures defined in ISO 16890-4 and the particulate removal efficiency is repeated on the conditioned filter element. This is done to provide information about the intensity of any electrostatic removal mechanism which may or may not be present with the filter element for test. The average efficiency of the filter is determined by calculating the mean between the initial efficiency and the conditioned efficiency for each size range. The average efficiency is used to calculate the ePM_x efficiencies by weighting these values to the standardized and normalized particle size distribution of the related ambient aerosol fraction. When comparing filters

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tested in accordance with the ISO 16890 series, the fractional efficiency values need to always be compared among the same ePM_x class (e.g. ePM_1 of filter A with ePM_1 of filter B). The test dust capacity and the arrestance of a filter element are determined as per the test procedures defined in this document.

The performance results obtained in accordance with ISO 16890 series cannot by themselves be quantitatively applied to predict performance in service with regard to efficiency and lifetime.

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Air filters for general ventilation —

Part 3:

Determination of the gravimetric efficiency and the air flow resistance versus the mass of test dust captured

1 Scope

This document specifies the test equipment and the test methods used for measuring the gravimetric efficiency and resistance to air flow of air filter for general ventilation.

It is intended for use in conjunction with ISO 16890-1, ISO 16890-2 and ISO 16890-4.

The test method described in this document is applicable for air flow rates between 0,25 m³/s (900 m³/h, 530 ft³/min) and 1,5 m³/s (5 400 m³/h, 3 178 ft³/min), referring to a test rig with a nominal face area of 610 mm × 610 mm (24 in × 24 in).

This document refers to particulate air filter elements for general ventilation having an ePM₁ efficiency less than or equal to 99 % and an ePM₁₀ efficiency greater than 20 % when tested as per the procedures defined in the ISO 16890 series.

NOTE The lower limit for this test procedure is set at a minimum ePM₁₀ efficiency of 20 % since it is very difficult for a test filter element below this level to meet the statistical validity requirements of this procedure.

This document does not apply to filter elements used in portable room-air cleaners.

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 15957, *Test dusts for evaluating air cleaning equipment*

ISO 16890-2:2022, *Air filters for general ventilation — Part 2: Measurement of fractional efficiency and air flow resistance*

ISO 16890-4, *Air filters for general ventilation — Part 4: Conditioning method to determine the minimum fractional test efficiency*

ISO 29463-1, *High efficiency filters and filter media for removing particles from air — Part 1: Classification, performance, testing and marking*

ISO 80000-1:2022, *Quantities and units — Part 1: General*

3 Terms and definitions

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

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

— ISO Online browsing platform: available at <https://www.iso.org/obp>

— IEC Electropedia: available at <https://www.electropedia.org/>

3.1 Air flow and resistance

3.1.1

air flow rate

volume of air flowing through an air cleaner per unit time

[SOURCE: ISO 29464:2024, 3.1.29, modified — The preferred term "flow rate" has been removed.]

3.1.2

resistance to air flow

difference in absolute (static) pressure between two points in an air flow system at specified conditions, especially when measured across the *filter element* (3.2.2)

Note 1 to entry: Resistance to air flow is measured in Pa (inches of water).

[SOURCE: ISO 29464:2024, 3.1.43, modified — The admitted terms have been removed; "at specified conditions, especially when measured across the filter element" has been added.]

3.1.3

final resistance to air flow

resistance to air flow (3.1.2) up to which the filtration performance is measured to determine the *test dust capacity* (3.3.4)

Note 1 to entry: Final resistance to air flow is measured in Pa (inches of water).

[SOURCE: ISO 29464:2024, 3.2.141, modified – "for classification or other purposes" has been replaced with "to determine the test dust capacity".]

3.1.4

initial resistance to air flow

resistance to air flow (3.1.2) of the clean filter operating at its test *air flow rate* (3.1.1)

Note 1 to entry: Initial resistance to air flow is expressed in Pa (inches of water).

[SOURCE: ISO 29464:2024, 3.2.142]

3.1.5

test air

air being used for testing purposes

[SOURCE: ISO 29464:2024, 3.1.44]

3.2 Test device

3.2.1

test device

air cleaner that is being subjected to performance testing

[SOURCE: ISO 29464:2024, 3.1.45, modified — The preferred terms "device under test" and "DUT" have been removed.]

3.2.2

filter element

structure made of the filtering material, its supports and its interfaces with the filter housing

[SOURCE: ISO 29464:2024, 3.2.59]

3.2.3

upstream

U/S

area or region from which fluid flows as it enters an air cleaner

[SOURCE: ISO 29464:2024, 3.1.46, modified — "U/S" has been added as an admitted term.]

3.2.4

downstream

D/S

area or region into which fluid flows on leaving an air cleaner

[SOURCE: ISO 29464:2024, 3.1.16, modified — "D/S" has been added as an admitted term.]

3.2.5

final filter

air filter used to collect the *loading dust* (3.3.5) passing through or shedding from the filter under test

[SOURCE: ISO 29464:2024, 3.2.62]

3.2.6

effective filter medium area

area of the filter medium contained in the filter through which air passes during operation

Note 1 to entry: This excludes areas covered by sealant, spacers, struts, etc.

Note 2 to entry: Effective filter medium area is expressed in m² (ft²).

[SOURCE: ISO 29464: 2024, 3.1.27]

3.3 Gravimetric efficiency

3.3.1

arrestance

measure of the ability of a filter to remove a standard test dust from the air passing through it under given operating conditions

Note 1 to entry: This measure is expressed as a mass fraction.

[SOURCE: ISO 29464:2024, 3.2.15, modified — The preferred term "gravimetric arrestance" has been removed; "mass percentage" has been replaced by "mass fraction" in note 1 to entry.]

3.3.2

initial arrestance

ratio of the mass of a standard test dust retained by the filter to the mass of dust fed after the first increment of dust load

Note 1 to entry: This measure is expressed as a mass fraction.

Note 2 to entry: For example, see the procedure in ISO 29461-1 or this document.

[SOURCE: ISO 29464:2024, 3.2.17, modified — The preferred term "initial gravimetric arrestance" has been removed; "mass percentage" has been replaced by "mass fraction" in note 1 to entry; the reference to "ISO 16890-3" has been replaced by "this document" in note 2 to entry.]

3.3.3

total arrestance

value of *arrestance* (3.3.1) determined after the last loading cycle in a filter test

3.3.4
test dust capacity

TDC

total mass of *loading dust* (3.3.5) captured by an air-cleaning device up to the final test *resistance to air flow* (3.1.2)

[SOURCE: ISO 29464:2024, 3.2.23, modified — The preferred terms "dust holding capacity" and "DHC" and the admitted term "dust loading capacity" have been removed.]

3.3.5
loading dust

synthetic dust formulated specifically for determination of the *test dust capacity* (3.3.4) and *arrestance* (3.3.1) of air filters

[SOURCE: ISO 29464:2024, 3.2.45, modified — The preferred term "synthetic test dust" has been removed.]

3.3.6
particle size

geometric diameter (equivalent spherical, optical or aerodynamic, depending on context) of the particles of an aerosol

[SOURCE: ISO 29464:2024, 3.2.116]

4 Symbols

A	Arrestance, %
A_j	Arrestance in loading phase "j", %
A_t	Total arrestance during test to final resistance to air flow, %
M_j	Mass of dust fed to the filter during loading phase "j", g
m_d	Dust in duct after filter, g
m_j	Mass of dust passing the filter at the dust loading phase "j", g
m_{tot}	Cumulative mass of dust fed to filter, g
m_1	Mass of final filter before dust increment, g
m_2	Mass of final filter after dust increment, g
p	Pressure, Pa
p_a	Absolute air pressure upstream of filter, kPa
p_{sf}	Air flow meter static pressure, kPa
q_m	Mass flow rate at air flow meter, kg/s
q_V	Air flow rate at filter, m ³ /s
q_{Vf}	Air flow rate at air flow meter, m ³ /s
t	Temperature upstream of filter, °C
t_f	Temperature at air flow meter, °C
ρ	Air density, kg/m ³

φ	Relative humidity upstream of filter, %
Δm	Dust increment, g
Δm_{ff}	Mass gain of final filter, g
Δp	Filter resistance to air flow, Pa
Δp_f	Differential pressure used for determination of air flow rate, Pa
$\Delta p_{1,20}$	Filter resistance to air flow at air density 1,20 kg/m ³ , Pa

5 General test device requirements

5.1 Test device requirements

The test device shall be designed or marked so as to prevent incorrect mounting. The test device shall be designed so that when correctly mounted in the ventilation duct, no air/dust leaks occur around the exterior filter frame and the duct sealing surfaces.

The complete test device (test device and frame) shall be made of material suitable to withstand normal usage and exposure to the range of temperature, humidity and corrosive environments likely to be encountered in service.

The complete test device shall be designed so that it will withstand mechanical constraints that are likely to be encountered during normal use. Dust or fibre released from the test device media by air flow through the test device shall not constitute a hazard or nuisance for the people (or devices) exposed to filtered air.

5.2 Test device preparation

The test device shall be mounted in accordance with the manufacturer's recommendations and after equilibration with the test air weighed to the nearest gram. Devices requiring external accessories shall be operated during the test with accessories having characteristics equivalent to those used in actual service. The test device, including any normal mounting frame, shall be sealed into the test rig in a manner that prevents leakages. The tightness shall be checked by visual inspection and no visible leaks are acceptable. If for any reason, dimensions do not allow testing of a test device under standard test conditions, assembly of two or more devices of the same type or model is permitted, provided no leaks occur in the resulting assembly. The operating conditions of such accessory equipment shall be recorded.

6 Loading dust

The loading dust as specified in ISO 15957 as L2 shall be used as a loading dust for reporting results. This procedure is applicable to loading a filtration device with other dust types mentioned in ISO 15957, but not for reporting results in accordance with this document.

7 Test equipment

7.1 Test rig

The test rig shall be as described in ISO 16890-2:2022, Clause 7. Parts not described in ISO 16890-2 and used in this document are described in [7.2](#) to [7.5](#).

7.2 Upstream mixing orifice

For all dust load measurements the upstream mixing orifice shall be installed.

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The mixing orifice is made up of an orifice plate (1) and a perforated plate as the mixing baffle (2) as shown in ISO 16890-2:2022, Figure 4.

7.3 Liquid aerosol testing devices

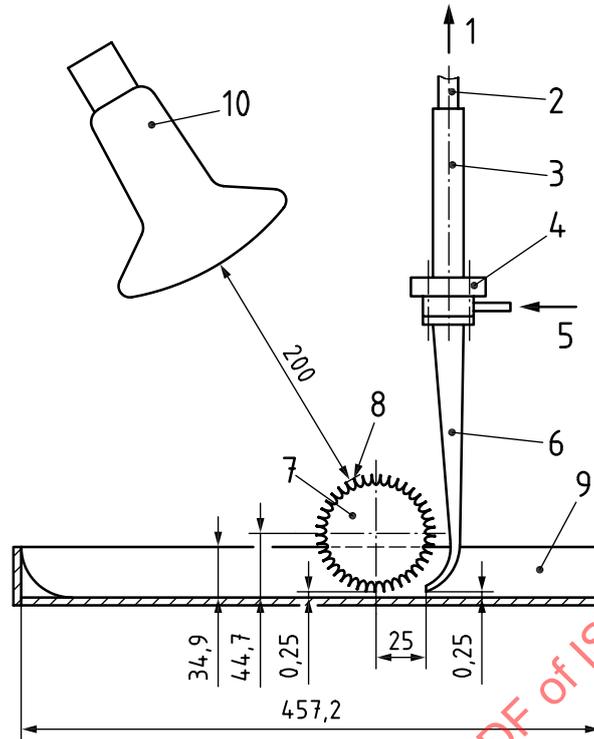
The downstream aerosol sampling head, upstream aerosol sampling head, downstream mixing orifice and aerosol injection as have been shown in ISO 16890-2:2022, Figure 3, are not used in this document.

7.4 Dust feeder

The purpose of the dust feeder is to supply the synthetic dust to the filter under test at a constant rate over the test period. A certain mass of dust previously weighed is loaded into the mobile dust feeder tray. The tray moves at a uniform speed and the dust is taken up by a paddle wheel and carried to the slot of the dust pickup tube of the ejector. The ejector disperses the dust with compressed air and directs it into the test rig through the dust feed tube. The dust injection nozzle in [Figure 1](#) shall be positioned at the entrance of duct section B as shown in ISO 16890-2:2022, Figure 3, and be collinear with the duct centre line:

The compressed air supply shall be fitted with a filter-dryer system to provide clean, oil-free air with a dew point no higher than 1,7 °C (35 °F). The general design of the dust feeder and its critical dimensions are given in [Figures 1](#) through [4](#). The vertical pickup tube version of the dust feeder is shown in [Figure 1](#) as an example. Backflow of air through the pickup tube from the positive duct pressure shall be prevented when the feeder is not in use. The degree of dust dispersion by the feeder is dependent on the characteristics of the compressed air, the geometry of the aspirator assembly and the rate of air flow through the aspirator. To ensure the consistency of the results, the test feeder shall provide $(140 \pm 14) \text{ mg/m}^3$ [$(4,0 \pm 0,4) \text{ g/1 000 ft}^3$]. The gauge pressure on the air line to the Venturi corresponding to an air flow of the dust feeder pipe of $(6,8 \pm 0,2) \text{ dm}^3/\text{s}$ ($14,4 \text{ cfm} \pm 0,4 \text{ cfm}$) shall be measured periodically for different static pressures in the duct.

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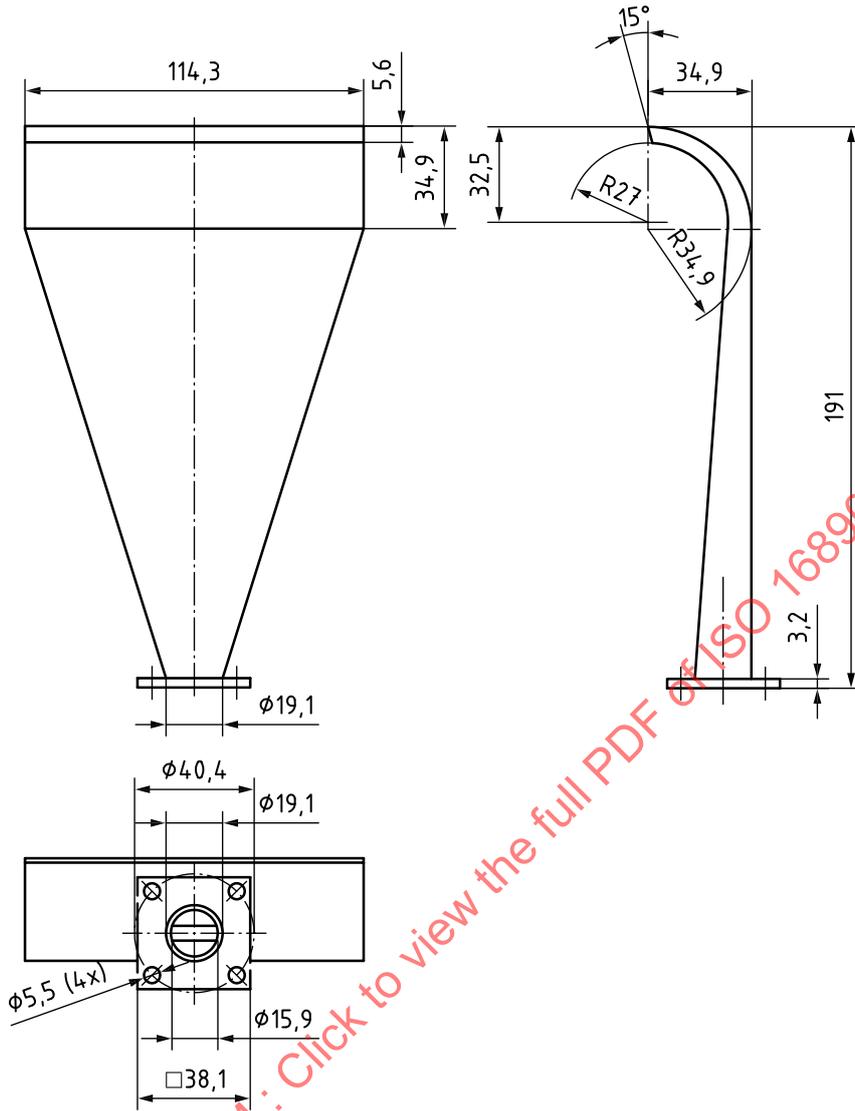


Key

- 1 dust feed tube (to inlet of test duct)
- 2 thin-wall galvanised conduit
- 3 Venturi ejector
- 4 ejector
- 5 dry compressed air feed
- 6 dust pickup tube (0,25 mm (0,01 in) from dust feed tray)
- 7 dust paddle wheel \varnothing 88,9 mm (3,5 in) (outer dimension), 114,3 mm (4,5 in) long with 60 teeth 5 mm (0,2 in) deep
- 8 teeth in paddle wheel (60 teeth)
- 9 dust feed tray
- 10 150 W infrared-reflector lamp

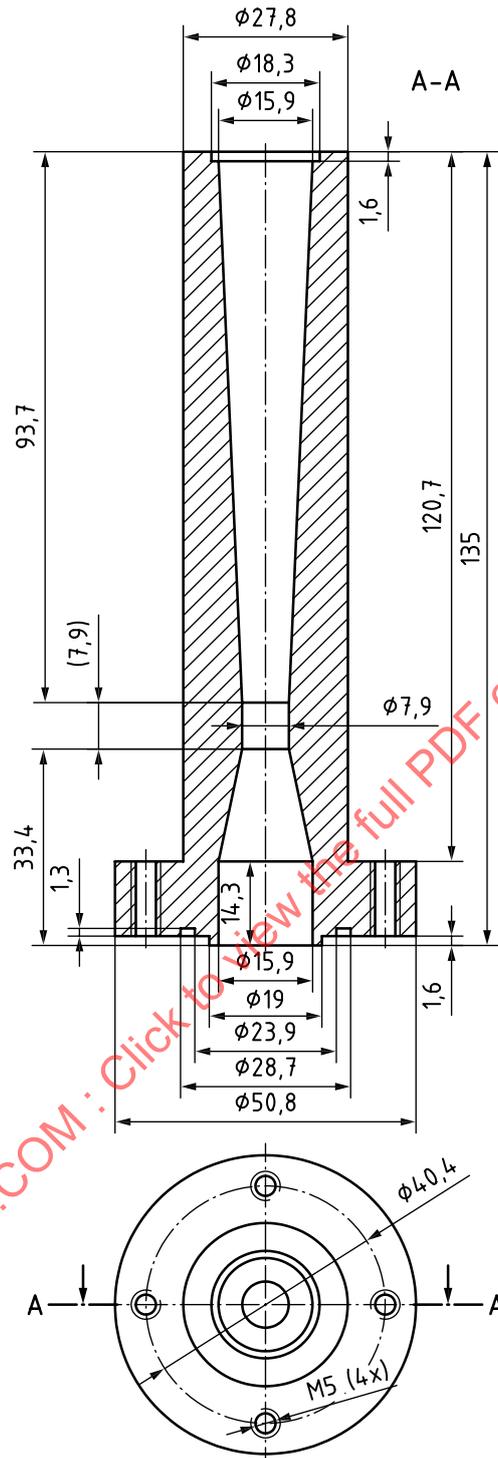
NOTE The optional infrared reflector lamp can be used if the dust is hygroscopic, making dust pickup easier.

Figure 1 — Critical dimensions of dust feeder assembly



Tolerances: for integers: 0,8 mm
for decimals: 0,03 mm

Figure 2 — Dust pickup tube details for the dust feeder



Tolerances: for integers: 0,8 mm
for decimals: 0,03 mm

Figure 4 — Venturi ejector tube details for the dust feeder

7.5 Final filter

The final filter captures any loading dust that passes through the test device during the dust loading procedure.

The final filter shall retain at least 98 % of the loading dust and have an ePM_{10} efficiency of at least 75 %. The design is optional, and it should not gain more than one gram as a result of humidity variations during one test cycle.

8 Qualification of test rig and apparatus

8.1 Schedule of qualification testing requirements

Apparatus qualification tests as described in ISO 16890-2:2022, Clause 8, shall verify quantitatively that the test rig and sampling procedures are capable of providing reliable arresstance measurements and resistance to air flow measurements. Maintenance testing helps to keep the system in good operating order. Additional cleaning and maintenance operations subject to any normal laboratory operation shall also be conducted beyond what is listed in ISO 16890-2:2022, Clause 8.

The dust feeding apparatus maintenance schedule is shown in [Table 2](#).

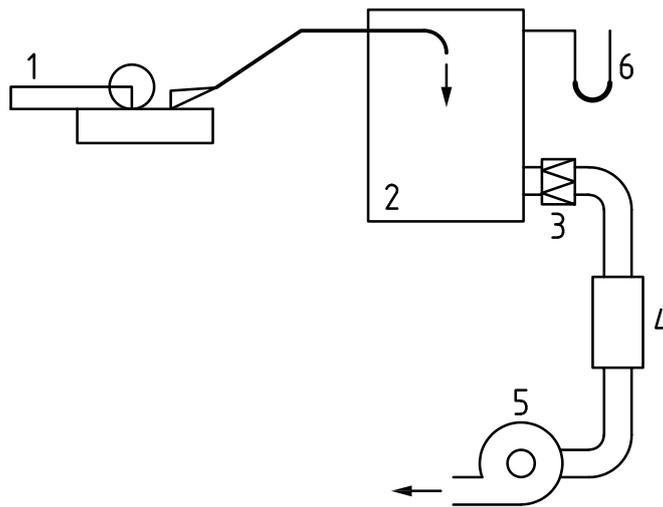
Table 2 — Dust feeding apparatus maintenance schedule

Maintenance item (Section reference)	Incorporate into each test	Monthly	Every 2 years	After any change that may alter per- formance	Comment
Dust feeder airflow rate as a function of discharge pressure (8.2)			X	X	
Measurement of Venturi dimensions for compliance with Figure 4				X	Every 500 h of operation
Inspection of dust feeder and its components for proper installation and operation		X		X	
Cleaning of dust feeder and its components	General cleaning of tray and removal of dust			X	Every 500 h of operation

8.2 Dust feeder air flow rate

The purpose of this test is to verify that the air flow rate for the dust feeder is correct.

The aspirator Venturi is subject to wear from the dust and compressed air and will thereby become enlarged. Therefore, the air flow rate from the dust feeder should be monitored periodically. The flow shall be $(6,8 \pm 0,2) \text{ dm}^3/\text{s}$ ($14,4 \text{ cfm} \pm 0,4 \text{ cfm}$) while maintaining the static pressures to $(0,0 \pm 0,1) \text{ Pa}$. If the measurement is outside the tolerance the Venturi shall be replaced. For other types of dust feeders, the air flow does not have to be the same as long as it gives the same test result as the dust feeder described in [7.4](#). The required gauge pressure on the ejector tube supply line necessary to provide this air flow at discharge duct pressures of at least 300 Pa ($1,2 \text{ inch H}_2\text{O}$) above ambient pressure shall be determined using the test device shown in [Figure 5](#).



Key

- 1 dust feeder
- 2 plenum with minimum volume of 0,25 m³ (8,8 ft³)
- 3 HEPA filter (ISO 29463-1 class ISO 40 H or higher efficiency)
- 4 flow metering device
- 5 fan
- 6 pressure differential measurement device

Figure 5 — Dust feeder air flow rate

8.3 Final filter efficiency qualification test

Weigh the final filter to the nearest 0,1 g and install it in the test duct without the test device installed. The method specified in 9.2.1 shall be used to challenge the filter with 100 g of loading dust. Remove and weigh the filter. Its weight increase shall be within 2 g of 100 g.

9 Test sequence dust-loading procedure

9.1 Test procedure for the filter

9.1.1 Preparation of the test device

The test device shall be mounted in accordance with the manufacturer's recommendations and after equilibration with the test air (23 ± 5) °C and RH (45 ± 10) % as defined in ISO 16890-2:2022, 7.1.4.2, weighed to the nearest gram. Devices requiring external accessories shall be operated during the test with accessories having characteristics equivalent to those used in actual practice. The filter, including any normal mounting frame, shall be sealed into duct in a manner that prevents leakages. The tightness shall be checked by visual inspection and no visible leaks are acceptable. If for any reason, dimensions do not allow testing of a test device within the applicable air flow rates of the duct [between 0,25 m³/s (900 m³/h, 530 ft³/min) and 1,5 m³/s (5 400 m³/h, 3 178 ft³/min) at standard test conditions], assembly of two or more test devices of the same type or model is permitted, provided that no leaks occur in the resulting test device. The operating conditions of such accessory equipment shall be recorded.

9.1.2 Initial resistance to air flow

Resistance to air flow shall be measured at 50 %, 75 %, 100 % and 125 % of the rated air volume flow rate as described in ISO 16890-2:2022, 9.1. These values establish a curve of resistance to air flow as a function

of the air flow rate. The resistance to air flow readings shall be corrected to an air density of 1,20 kg/m³ (0,075 lb/ft³). See [Annex A](#).

NOTE When measuring the initial resistance, the upstream mixing orifice as described in [7.2](#) can cause incorrect measurements due to turbulent air flow.

9.2 Dust loading

9.2.1 Dust loading procedure

The test device is progressively loaded with the synthetic test dust and the consequent changes in resistance to air flow are determined. Dust increments are weighed to ±0,1 g and placed in the dust tray. The dust is fed to the test device at a concentration of (140 ± 14) mg/m³ (4,0 ± 0,4 g/1 000 ft³) until each air flow resistance step value is attained. Before stopping the dust feeding, brush whatever dust remains in the feeder tray to the dust pickup tube so that it is entrained in the duct air flow. Vibrate or rap the dust feeder tube for 30 s. The dust fed to the test device can also be estimated by weighing the remaining dust in the feeder. With the test air flow on, re-entrain any synthetic dust in the duct upstream of the test device by the use of a compressed air jet directed obliquely away from the tested test device.

Stop the test and reweigh the final filter (to at least 0,5 g accuracy) to determine the amount of synthetic dust collected and calculate the arrestance. Any dust deposited in the duct between the test device and the final filter should be collected with a fine brush and included in the final filter weight.

The first 60 g dust loading [or 10 Pa (0,04 inch H₂O)] increase, whichever comes first, will give the initial arrestance and the additional dust increments should give a smooth curve for the arrestance versus dust loading up to the final resistance.

For filters with particle removal efficiency < 50 % in the PM₁₀ particle range, the final resistance to air flow is 200 Pa (0,8 inch H₂O), while for filters with a particle removal efficiency ≥ 50 % in the PM₁₀ particle range, the final resistance to air flow is 300 Pa (1,2 inch H₂O).

Reporting shall be conducted at these final resistance to air flow values, but testing can go beyond these values.

The test dust loading curve should be built up by a minimum of five data points evenly distributed to create a smooth curve. However, a filter with low initial pressure loss, or a filter with low increase of pressure versus loading dust, requires one or more measuring points in the beginning of the dust loading procedure, while other filters can need an extra measuring point at the end of the dust loading procedure to give an even distribution of measuring points (see [Table 3](#)).

Table 3 — Performance values to measure or calculate after each dust loading step

Stage	Parameter to be determined		
	Arrestance	Test dust capacity	Resistance to air flow
Initial, before dust loading	NO	NO	YES
After 60 g dust, or 10 Pa (0,04 inch H ₂ O) increase, whichever comes first (the first loading to give initial arrestance)	YES	NO	YES
At the end of each intermediate increment	NO	NO	YES
After the last increment (final resistance to air flow)	NO	YES	YES

9.2.2 Arrestance

The initial arrestance is calculated after the first 60 g loading dust [or 10 Pa (0,04 inch H₂O) increase, whichever comes first]. Then the previously weighed final filter is removed from the test rig and reweighed.

The mass increase indicates the mass of dust that has passed the test device. The arrestance, A_i , for the initial dust loading step shall be calculated as given in [Formula \(1\)](#):

$$A_i = \left(1 - \frac{m_i}{M_i}\right) \times 100 \% \quad (1)$$

where

m_i is the mass of dust passing the filter (the mass gain of final filter Δm_f and the dust remaining in the duct after the test device m_d) at the initial dust loading phase;

M_i is the mass of loaded dust (dust increment Δm) during the initial dust loading phase.

The initial arrestance is calculated after the first 60 g loading dust [or 10 Pa (0,04 inch H₂O) increase, whichever comes first]. If the dust loading test is stopped, the test dust capacity shall be reported as “not applicable due to loss of arrestance during loading process”.

The total arrestance is calculated after the dust loading process is completed per [9.2.1](#). The total arrestance, A_t , shall be calculated as given in [Formula \(2\)](#):

$$A_t = \left(1 - \frac{m_t}{M_t}\right) \times 100 \% \quad (2)$$

where

m_t is the mass of dust passing the filter (the mass gain of final filter Δm_f and the dust remaining in the duct after the test device m_d) at the total dust loading phase;

M_t is the mass of loaded dust (dust increment Δm) during the total dust loading phase.

Initial arrestance or total arrestance values above 95 % shall be reported as > 95 %.

9.2.3 Test dust capacity

The test dust capacity for a given final resistance to air flow is calculated by multiplying the total mass of loaded dust (corrected for the losses upstream of the test device, as described in [9.2.1](#)) by the total arrestance, A_t . If the total arrestance value is above 95 %, a total arrestance value of 95 % shall be used to calculate the test dust capacity.

10 Reporting results

10.1 General

Test results should be reported using the test report format shown in [Table 4](#) and [Table 5](#) which comprise the complete test report and are examples of acceptable forms. Use of this exact format is not required, but the test report shall include all the items shown in [10.2.2](#) and [10.2.3](#). Any report not containing all required elements shall be considered invalid.

10.2 Required reporting elements

10.2.1 Report values

All data values for arrestance shall be reported as an integer percentage value. Values shall be rounded to a rounding range 1 percentage point.

Data values for resistance to air flow shall be reported as an integer value in SI units (Pa). Values shall be rounded to a rounding range of 1. For IP units (inch H₂O) values shall be rounded to a rounding range of 0,01.

All rounding shall be per ISO 80000-1:2022, Clause B.3, Rule A.

10.2.2 Report summary

The one-page summary section of the performance report (see [Table 4](#)) shall include the following information:

- a) laboratory information:
 - 1) laboratory name;
 - 2) laboratory location and contact information;
 - 3) test operator's name(s);
 - 4) method of air flow measurement;
- b) test information:
 - 1) reference to this document, i.e. ISO 16890-3:2024;
 - 2) unique test report identification;
 - 3) date of the test;
 - 4) how the sample was obtained;
- c) test device information:
 - 1) manufacturer's name (or name of the marketing organization, if different from the manufacturer);
 - 2) brand and model number as marked on the test device;
 - 3) test device condition (e.g. clean, discharged in accordance with ISO 16890-4, tested in accordance with ISO 16890-2, used, etc.);
 - 4) dimensions (height, width and depth);
 - 5) physical description of construction (e.g. pocket filter, number of pockets; pleated panel, number and depth of pleats);
 - 6) media description including:
 - i) type of media with description and identification code (e.g. glass fibre ABC123, inorganic fibre 123ABC), if known;
 - ii) media colour;
 - iii) effective filter medium area;
 - iv) type and amount of any additive to the media, if known;
 - v) electrostatic charge, if known;
 - 7) a photo of the actual test device is highly recommended, but not required;
 - 8) any other pertinent descriptive attributes;
- d) test device literature data or operating data as stated by the manufacturer, if known:
 - 1) test device initial resistance to air flow at the test air flow rate;
 - 2) rated final resistance to air flow at the test air flow rate;
 - 3) initial particle removal efficiency per ISO 16890-2;

- 4) any other literature data available or furnished operating data;
- e) test conditions:
 - 1) test air flow rate;
 - 2) test air temperature and relative humidity;
 - 3) loading dust used;
- f) test data:
 - 1) resistance to air flow data at the test air flow rate;
 - 2) resistance to air flow versus test dust captured.

10.2.3 Report details

The report details (see Figure 7) shall include but are not limited to the following information.

- a) Measured results.
 - 1) The resistance to air flow data at each of the required air flow rates shall be reported in table format (see [Table 6](#)) and as a graph of air flow versus resistance to air flow.

The reported resistance to air flow shall be corrected to an air density of $1,20 \text{ kg/m}^3$. However, if the test air density is between $1,16 \text{ kg/m}^3$ ($0,072 \text{ lb/ft}^3$) and $1,24 \text{ kg/m}^3$ ($0,077 \text{ lb/ft}^3$), no corrections need to be made. The corrections are described in [Annex A](#).
 - 2) The results of the arrestance measurement shall be reported both in table (summary page) (see [Table 7](#)) and graphical format.
- b) Concluding statement.

The results of this test relate only to the test device in the condition stated herein. The performance results cannot by themselves be quantitatively applied to predict filtration performance in all “real life” environments.

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Table 4 — Test report summary page format

ISO 16890-3:2024 - AIR FILTER TEST RESULT SUMMARY				Testing Organization	
				Name	
				Address	
				Phone	
GENERAL					
Test ID:		Date of test:		Operator:	
		Airflow measurement:		Test sample obtained:	
DEVICE TESTED					
Model:		Manufacturer:		Filter dimensions (W x H x D) (mm):	
Type of media:		Net effective media area (m ²):		Construction: (# pleats, pockets, etc.)	
Filter/media electrostatic charge:		Media colour:		Media adhesive:	
Device Condition: (clean/initial, used, conditioned per ISO 16890-4, tested per ISO 16890-2, etc.)					
Other descriptive information:					
TEST DATA SUMMARY					
Test air flow rate (m ³ /s):		Test air temperature (°C):		Test air RH (%):	
				Loading dust:	
RESULTS					
Resistance to airflow (Pa)			Dust loading results		
Measured:	Rated Initial:		Initial arrestance [%]		Test Dust capacity [g]
	Rated Final:				
Test Device Photo					
Remarks:					
NOTE					
The results of this test relate only to the test device in the condition stated herein.					
The performance results cannot by themselves be quantitatively applied to predict filtration performance in all "real life" environments.					
Units are shown in SI, but can be converted to IP					

Table 5 — Test report details page format

ISO 16890-3:2024 - AIR FILTER TEST RESULT DETAILS			Testing Organization	
			Name	
			Address	
			Phone	
Test ID:		Date of test:		Operator:
TEST DATA DETAILS				
Resistance to Air flow				
% of Rated Air flow	Air flow (m ³ /s)	Resistance to Air flow (Pa)		
50 %				
75 %				
100 %				
125 %				
			Key X air flow (m ³ /s) Y resistance to Air flow (Pa)	

Table 6 — Example of test report: air flow rate and resistance to air flow after different dust loading phases

ISO 16890-3:2024 - Air flow rate and resistance to air flow after different dust loading phases													
Test device:													
Test no.:													
Test aerosol:													
Air flow rate: m ³ /s													
Date	Loaded dust <i>m</i> _{tot} g	Air flow meter				Filter							
		<i>t</i> _f °C	<i>p</i> _{sf} kPa	Δp_f Pa	<i>q</i> _m kg/m ³	<i>t</i> °C	φ %	<i>p</i> _a kPa	ρ kg/m ³	<i>q</i> _v m ³ /s	Δp Pa	$\Delta p_{1,20}$ Pa	
Clean filter													
yyyy-mm-dd													
yyyy-mm-dd													
yyyy-mm-dd													
yyyy-mm-dd													
yyyy-mm-dd													
Clean filter resistance to air flow is proportional to (<i>q</i> _v) ^{<i>n</i>} , where <i>n</i> =													
Dust loading phase													
yyyy-mm-dd													
yyyy-mm-dd													
Symbols and units													
<i>m</i> _{tot}	Cumulative mass of loaded dust to filter, g				<i>t</i> _f	Temperature at air flow meter, °C							
<i>p</i> _a	Absolute air pressure upstream of filter, kPa				ρ	Air density upstream of filter, kg/m ³							
<i>p</i> _{sf}	Air flow meter static pressure, kPa				φ	Relative humidity upstream of filter, %							
NOTE	Units are shown in SI, but can be converted to IP.												