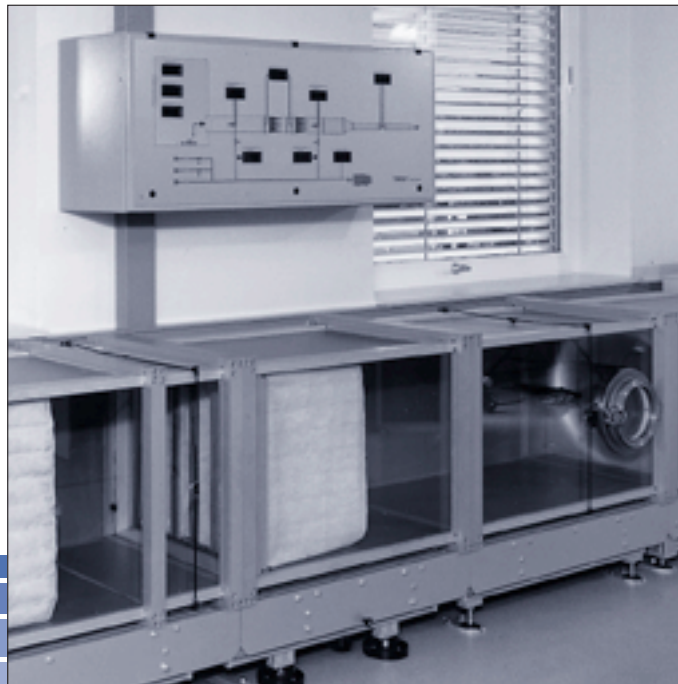


Air Filter Test

to EN 779
(ASHRAE STANDARD 52-76)



TROX® **TECHNIK**

Description

The standard EN779 “Particle air filters for general ventilation and air conditioning purposes” is a revised version of the ASHRAE STANDARD 52-76, which has been used internationally as a guideline for testing of air filters, and has been used as a basis for various national standards.

Designers and end users can in future refer to the specifications of this standard and in addition it is possible to request relevant test certificates from an independent test centre, giving the guarantee that the specifications of the

manufacturer are correct. There are now a number of test centres in Germany and Europe in general who can test to this specification.

Comparative performance of air filters can only be assessed by means of independent laboratory test carried out under controlled conditions. This, coupled with clear, uniform presentation of technical data eliminates subjective and mis-informed decision-making and enables the correct choice of filter to be made.



Task of the air filter test

The test method in standard to EN779 (ASHRAE STANDARD 52-76) can be used for performance evaluation of air filters up to atmospheric dust spot efficiencies of 98%¹⁾ and provide the following specific information:

- Atmospheric dust spot efficiency
- Synthetic dust weight arrestance
- Pressure loss
- Dust holding capacity.

The test is carried out using two types of dust: atmospheric dust, i.e. the natural air contamination present at the place of testing, and with synthetic dust, comprising 72% by weight standardised fine test dust, 23% by weight coal dust, 5% cotton linters.

According to the type of dust used, the following are determined:

- Atmospheric dust spot efficiency i.e. a measure of the capacity of the test object to separate atmospheric dust from the test air.
- Synthetic dust weight arrestance i.e. a measure of the capacity of the test object to separate the synthetic dust fed in to the test air.

Furthermore, the following characteristic features of the air filter are determined:

- Pressure loss of the test object as a function of the face velocity in clean condition and as a function of the dust fed.
- Dust holding capacity of the test object is calculated, for all disposable filters and air filters without self renewal of the filter media²⁾, by the product of the dust fed and the average degree of arrestance. Dust holding capacity is not referred to a specific area.

¹⁾This is the upper limit of this test method due to measuring accuracy (values above 98 % are no longer given). High efficiency air filters are tested to a different method e.g. to EN 1822.

²⁾Filter media for automatic roll filters, defined as air filters with self-renewal of the filter media, are tested in accordance with a different test procedure.

Test Equipment and Test Procedure

Figure 1 shows the schematic layout of the test section, including all necessary equipment for determining the efficiency with atmospheric dust and the degree of arresance with synthetic dust.

To determine the performance characteristics already discussed, testing to EN 779 (ASHRAE STANDARD 52-76) is carried out in various stages:

Determination of Pressure Loss

After installing the test object into the test section, its initial pressure loss is measured with at least four volume flows from 50, 75, 100 and 125 % of its rated volume flow, i.e. at various face velocities.

Atmospheric Dust Spot Efficiency

The next stage in testing is to obtain the atmospheric dust spot efficiency. For this test object is subjected to atmospheric test air (outside air with natural level of contamination without further treatment). By means of probes on the inlet

and outlet side of the test object (figure 2) equal sample volume flows are taken from the test air, this is continuous on the downstream side and intermittent on the upstream side. The dust content from the sample air is separated by means of white filter papers (figure 3), the translucence of which is then compared by means of photo-electric testing of light transmission.

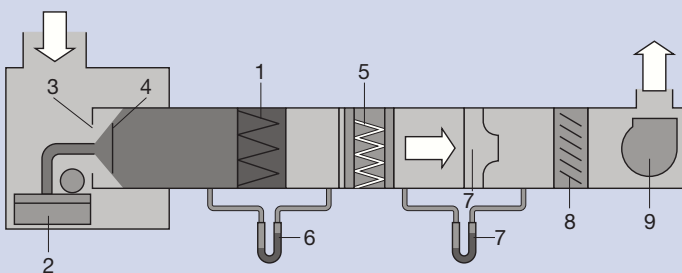
The efficient E with atmospheric dust is obtained by:

$$E = 100 \left[1 - \frac{Q_1}{Q_2} \times \frac{O_2}{O_1} \right]$$

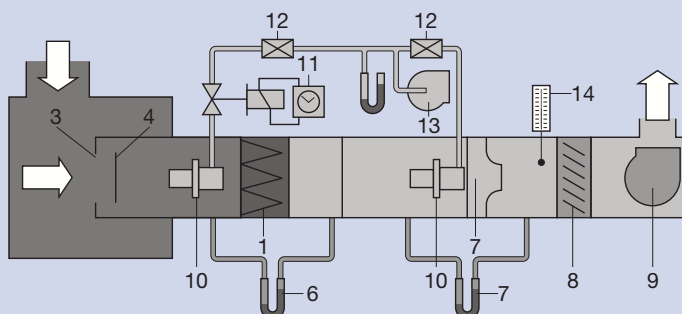
The definitions are:

- Q₁: Total volume of the test air taken from the upstream side
- Q₂: Total volume of the test air taken from the downstream side
- O₁: Opacity of the test object on the upstream side
- O₂: Opacity of the test object on the downstream side

Figure 1:
Layout of the test section (schematic)



Part 1:
Set up for determination of synthetic dust weight arresance



Part 2:
Set up for determination of atmospheric dust spot efficiency.

- | | |
|---|---|
| <ul style="list-style-type: none"> 1. Test object 2. Dust feed device 3. Mixer orifice 4. Perforated plate 5. Final filter 6. Measuring device for pressure loss 7. Measuring device for volume flow | <ul style="list-style-type: none"> 8. Flow straightener 9. Fan 10. Probe (sampling tube) 11. Timer 12. Volume tester meter 13. Vacuum pump 14. Temperature and relative humidity of test air |
|---|---|

Test Equipment and Test Procedure

In all cases, at least two tests are carried out consecutively the results of which are used to provide the average value.

Synthetic dust weight arrestance

To determine the synthetic dust weight arrestance, the test air is charged with synthetic dust through a feeder to provide a concentration of approx. 70 mg/m^3 . The dust not separated by the test object is collected by a final filter (for subsequent analysis). From this data a degree of arrestance A can be determined from the weight increases:

$$A = 100 \left[1 - \frac{W_2}{W_1} \right]$$

The definitions are:

W_1 : Weight of the synthetic dust fed

W_2 : Weight of the synthetic dust not separated by the test object

Determination of Dust Holding Capacity

The dust holding capacity of a test object can be calculated from the measured results available. For disposable air filters and air filters without self-renewal media this is the weight of synthetic dust which has been retained by the test object at the conclusion of the test, i.e. the product of total weight of dust fed times the average degree of arrestance.

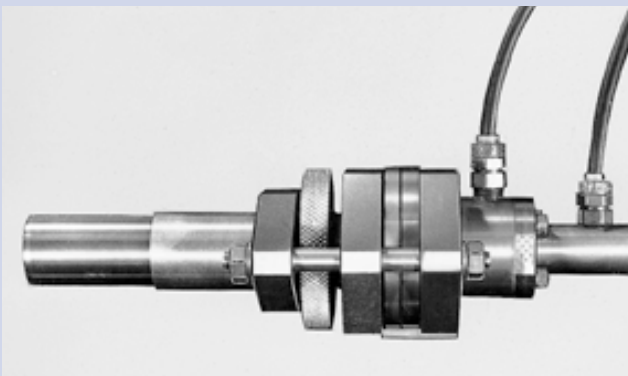


Figure 2: Probe with filter paper holder and critical flow nozzles which provide partial volume flows on the upstream and downstream sides.



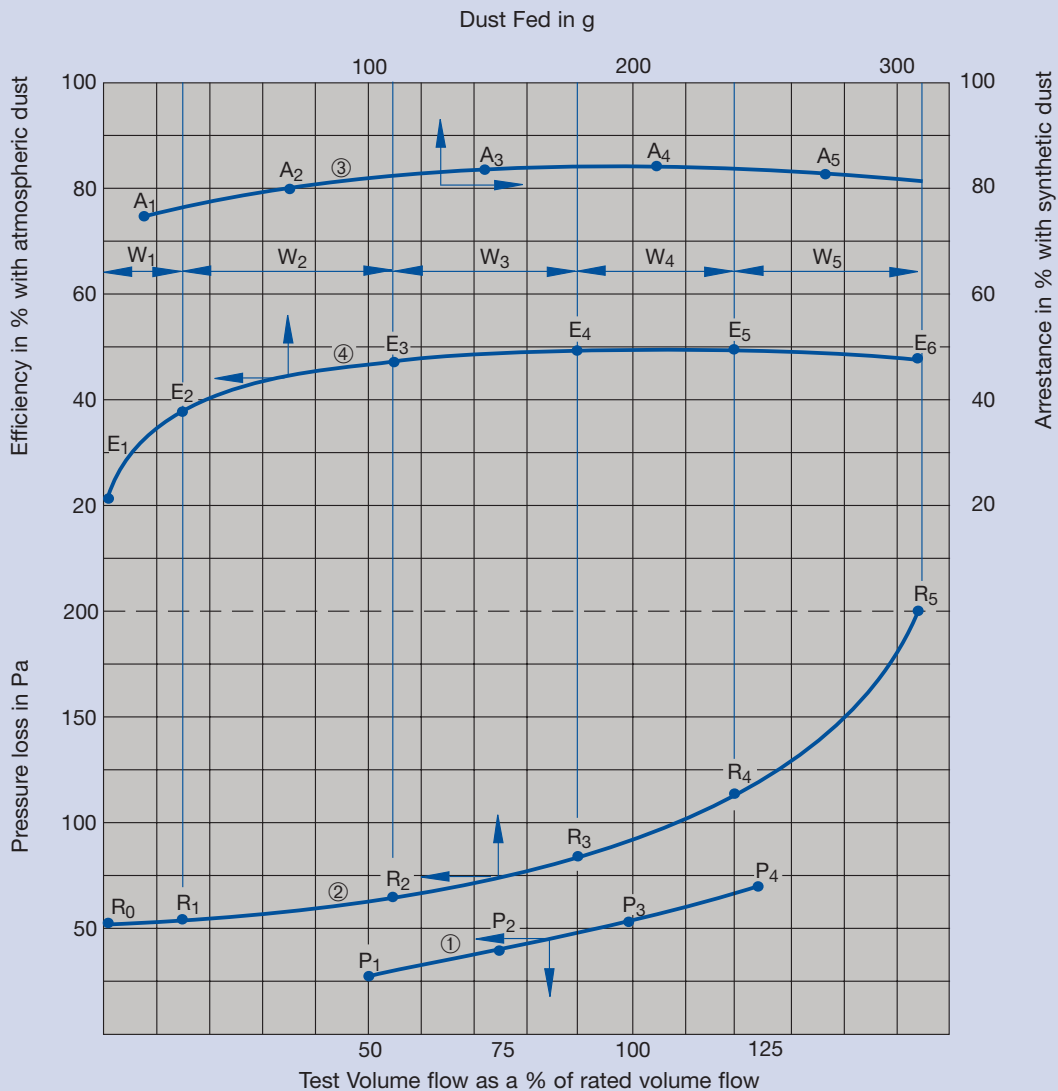
Figure 3: Target holder for filter papers used for opacity tests.



Figure 4: Dust feed device with ejector tube in front of mixer opening with perforated plate of test section.

Presentation of the Test Results

- ① Pressure loss of the clean test object as a function of volume flow.
- ② Pressure loss of the test object as a function of the dust fed. The variation in pressure loss characterises the behaviour of the test object as dust accumulation increases. Also it shows the final point at the end of the test which has been used to determine mean efficiency – arrestance ratings and the point to which dust holding capacity is related.
- ③ Degree of synthetic dust weight arrestance as a function of the dust fed.
The variation of arrestance ($A_1 \dots A_n$) is determined from the results of successive dust feeds. In most cases as the filter collects dirt there is also an increase in arrestance efficiency. This can be seen from the curve shown.
- ④ Atmospheric dust spot efficiency as a function of the dust fed.
This curve is based on the initial efficiency found before the first dust feed (E_1) and efficiencies are determined after successive dust feeds ($E_2 \dots E_n$). Again efficiency will generally increase with increasing dust accumulation.



Air Filter Classification

Air filters are divided into filter grades G1 to G4 or F5 to F9 according to their test results to EN 779 part 1, as shown in the table below. This table also shows the filter classification to DIN 24 185 and a comparison with the previous standard division of quality classes to StF.

However, it is not always possible to allocate the previous division of quality classes to the present filter classification system.

Filter grades to EN 779			Filter grades to DIN 24 185 part 2			Quality Classification grades based on StF ¹⁾	
Filter grade	Average synthetic dust weight arrestance A_m in %	Average atmospheric dust spot efficiency E_m in %	Filter grade	Average synthetic dust weight arrestance A_m in %	Average atmospheric dust spot efficiency E_m in %	Quality-grade	Description
G 1	$A_m < 65$	–	EU 1	$A_m < 65$	–	A	Coarse dust filter
G 2	$65 \leq A_m < 80$	–	EU 2	$65 \leq A_m < 80$	–		
G 3	$80 \leq A_m < 90$	–	EU 3	$80 \leq A_m < 90$	–	B	Fine dust filter
G 4	$90 \leq A_m$	–	EU 4	$90 \leq A_m$	–		
F 5	–	$40 \leq E_m < 60$	EU 5	–	$40 \leq E_m < 60$	C	High efficiency fine dust filter
F 6	–	$60 \leq E_m < 80$	EU 6	–	$60 \leq E_m < 80$		
F 7	–	$80 \leq E_m < 90$	EU 7	–	$80 \leq E_m < 90$		
F 8	–	$90 \leq E_m < 95$	EU 8	–	$90 \leq E_m < 95$		
F 9²⁾	–	$95 \leq E_m$	EU 9 ²⁾	–	$95 \leq E_m$		

¹⁾ Classification into quality grades based on “Guidelines for method of testing air filters used in general ventilation” published by the Dust Research Institute of the General Federation of Industrial Trades Associations (Reg. Soc.) in Bonn. This was replaced by the air filter classification to DIN 24 185.

²⁾ Air filters with a high average efficiency such as absolutes can be graded by DIN 24 184 “Type-testing of Absolute Filters”.

Type Testing

Trox filter media are type-tested to EN779 Part 1 by the State Materials Testing Institute – MPA, a recognized independent institute.

The performance data established by the Test Centre is given in an official test certificate, an abridged example of which is shown. Other test certificates for various media are available in separate leaflets.

After successful type testing to EN779 Part 2 and issue of approval document, the filter media will be coded with the DIN Test and Monitoring symbol with a type number (see below for an example for approval document).

Designers, manufacturers and end users of ventilation/air conditioning equipment can in future use the test data based on the draft standard EN 779 (equivalent to ASHRAE 52-76) as a means of providing valid direct performance comparisons for various air filters.

MATERIALPRÜFUNGSAMT NORDRHEIN-WESTFALEN **MPA NRW**

Marsbruchstraße 186, 44287 Dortmund-Aplerbeck · Postanschrift: 44285 Dortmund · Telefon (02 31) 45 02 - 0 · Telefax (02 31) 45 85 49

Kurzfassung des Prüfzeugnisses Nr. **41 0221 3 95**

Ort, Datum der Prüfung: Dortmund, 16.10.1995		Gültig bis: 27.10.2000	
Bezeichnung *)	Nr. des Modells *)	Hersteller	Auftraggeber
Beutelfilter	F743 F04	Gebrüder Trox GmbH	Gebrüder Trox GmbH
Typ des Filtermediums *)	Freie Filterfläche in m ² *)	Frontabmessungen in mm	Tiefe in mm
Chemiefaservlies	2,6	592 x 592	360
			Dicke in mm

			Ausführung
			6 Taschen

Betriebliche Daten des Herstellers

Nennvolumenstrom in m ³ /s	Anfangs-Druckdifferenz in Pa	Endwert der Druckdifferenz in Pa
0,94 (3400 m ³ /h)	35	250

Prüfbedingungen

Temperatur der Prüfluft in °C	Rel. Luftfeuchte der Prüfluft in %	Volumenstrom bei der Prüfung in m ³ /s	Durchmesser der Einläuföffnung der Entnahmesonde in mm	Staubkonzentration in mg/m ³
20 - 25	66 - 74	0,94 (3400 m ³ /h)	---	70 ± 10 %

Prüfergebnisse nach DIN EN 779, weitere Prüfergebnisse auf der Rückseite

Anfangsdruckdifferenz bei 100 % Nennvolumenstrom in Pa	Anfangswirkungsgrad gegenüber atmosphärischem Staub in %	Mittlerer Wirkungsgrad gegenüber atmosphärischem Staub in %	Endwert der Druckdifferenz in Pa
36	---	---	250
Anfangsabscheidegrad gegenüber synthetischem Staub in %	Mittlerer Abscheidegrad gegenüber synthetischem Staub in %	Staubspeicherfähigkeit in g	Filterklasse
87,7	93,2	1581	G 4

Dortmund, 27.10.1995
Im Auftrag

Müller
Sachbearbeiter

MATERIALPRÜFUNGSAMT NORDRHEIN-WESTFALEN

Erläuterungen auf der Rückseite
*) Nach Angaben des Herstellers / Auftraggebers

Test Certificate

DIN CERTCO Gesellschaft für Konformitätsbewertung mbH

DIN

GENEHMIGUNG
zum Führen des DIN-Prüf- und Überwachungszeichens

ERSTGENEHMIGUNG

Genehmigungsinhaber: Gebrüder Trox GmbH
Heinrich-Trox-Platz
47504 Neukirchen-Vluyn

Produkt: Partikel-Luftfilter für die allgemeine Raumlufttechnik

Typbezeichnung: F743 F04

Register-/Baunummer: PFE012/95

Gültig bis: 31.10.2000

Ausstellungsdatum: 01.02.1996

DIN GEPRÜFT

Fortsetzung Seite 2

DIN CERTCO, Buggrabenstraße 6, 10787 Berlin, Tel.: (0 30) 28 01-0 Fax: (0 30) 28 01-16 10 Geschäftsleitung: Dipl.-Ing. J. Neun, Prof. Dr.-Ing. H. Rehnert, Dipl.-Vw. D. Volkmann

Approval Document