Background

Air filters are used to separate particulate and gaseous contaminants. This application overview describes various test system solutions for the comprehensive evaluation of highly effective EPA, HEPA and ULPA particle filters.

Topas test systems are used since 1995 for quality control in production as well as for research and development of new filter elements and filter materials.

Applications

- differential pressure tests
- visual inspection of filter elements
- determination of the integral and local separation efficiency
- leak detection and verification
- confirmation of the nominal filter class

The test systems for highly effective particle filters are designed primarily for the evaluation of clean-room filters, which are used, for example, in micro-electronics, pharmaceutics, medical technology, but also in air conditioning systems and mobile room air systems.

Different requirements are placed on the test system, the test procedures and the test report, depending on the application for which the filter is to be tested. Additionally, there are customer-specific requirements for the test.

Application-specific requirements

- size and geometry of the filter media
- flow rate or flow velocity
- test aerosol (DEHS, PAO, PSL, NaCl, KCl)
- integral vs. local measurement
- reference particle size

test	standard	test systems
MPPS – filter media	ISO 29463-3 EN 1822-3	AFS 153
leak detection, local separation efficiency	ISO 29463-4 EN 1822-4	AFS 150 (2d) AFS 151 (3d) AFS 152 (2d) AFS 152/A (2d) AFS 155
integral separation efficiency	ISO 29463-5 EN 1822-5	AFC 136 AFS 150 AFS 151 AFS 152

Features

- standardised test setups
- modular structure and instrumentation
- high degree of automation
- software-based test sequences
- standardised test report

The necessity of a local separation efficiency measurement depends on the nominal filter class. HEPA and ULPA filters should be scanned if possible.

filter class	integral separation efficiency	local separation efficiency
ISO 15 E	≥95 %	-
ISO 20 E	≥99 %	-
ISO 25 E	≥99,5 %	-
ISO 30 E	≥99,90 %	-
ISO 35 H	≥99,95 %	≥99,75 %
ISO 40 H	≥99,990 %	≥99,95 %
ISO 45 H	≥99,995 %	≥99,975 %
ISO 50 U	≥99,9990 %	≥99,995 %
ISO 55 U	≥99,9995 %	≥99,9975 %
ISO 60 U	≥99,99990 %	≥99,9995 %
ISO 65 U	≥99,99995 %	≥99,99975 %
ISO 70 U	≥99,999990 %	≥99,9999 %
ISO 75 U	≥99,999995 %	≥99,9999 %

AFS 153 – MPPS Measurement Filter Media

In accordance to ISO 29463-3, the most penetrating particle size (MPPS) has to be determined on the flat filter media before measuring the separation efficiency on the filter element. For this purpose, a solid filter holder AFS 153 was developed. It can be used separately with the corresponding instrumentation for particle generation, conditioning and measurement. Alternatively, the filter holder can be integrated as an add-on into many Topas test systems using the existing instrumentation for MPPS determination.
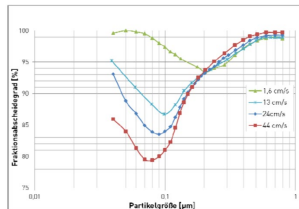
AFS 153 media tester and typical MPPS curves.

AFS 155 – Oil Thread Leak Test

For a simple visual inspection of filter elements, the AFS 155 test system is available. During the so-called oil thread test, leaks in the filter element can be detected on the downstream side as an oil string. Both planar filter elements and filter cartridges can be used with the test system. Typically, the test is not carried out at the nominal volume flow rate of the test object. By using a particle counter and a suitable probe, the filter surface can also be scanned manually. However, since the test system has no control or evaluation software, there is no protocol printout.

- visual inspection of filter elements according to ISO 29463-4 attachment A
- filters up to (1 220 × 1 220 × 300) mm
- flow rate 3 ... 36 m^3/h
- test aerosol DEHS

AFS 155 Oil Thread Leak Test.

AFS 152 – Manual Filter Scanner

The manual filter scanner was designed as a simple and cost-effective test setup for determining the integral and local separation efficiency of EPA, HEPA and ULPA filters. To achieve this, the footprint was reduced to a minimum. The required inflow unit is offered optionally. In the original design, the filter is scanned by hand. Nevertheless, the scanned surface is recorded via an x-y coordination that enables to document the complete inspection of the filter surface. The test report created with the associated test system software AFSWin fully complies with the standardised requirements.
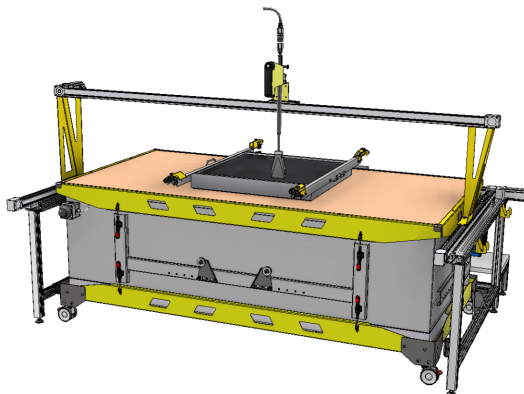

AFS 152 Manual Filter Scanner.

- integral and local separation efficiency, leak detection
- filters up to (1 830 × 915 × 300) mm
- flow rate 150 ... 2 000 / 300 ... 4 000 m³/h
- test aerosol: DEHS, PSL

The manual filter scanner AFS 152 can be equipped with either one or two particle counters. During the probe run over the filter cross-section, all particle events are summarised, resulting in the integral separation efficiency. If a fast, exclusively integral efficiency measurement is needed, a corresponding measuring hood can be used.

AFS 152/I with hood for integral efficiency measurement.

The latest development is a fully automated version which enables to scan the filter with the aid of traversing. This solution reduces the manual operating effort of the test system to a minimum.

AFS 152/A automatic version with traversing.

AFS 150 – Automatic Filter Scanner

This all-automatic test system version meets all normative requirements. The dimensioning of the intake geometry, which involves a correspondingly large footprint, ensures particularly precise volume flow measurement and optimal aerosol distribution across the filter cross-section. The test system can be optionally equipped with 1 to 4 sampling probes and particle counters on the downstream side.

AFS 150 Automatic Filter Scanner.

- integral and local separation efficiency, leak detection
- filters up to (1 830 × 1 220 × 300) mm
- flow rate 120 ... 5 000 m³/h
- test aerosol: DEHS, PSL

Because of the high accuracy and the high level of automation the automatic filter scanner AFS 150 is especially suitable for 100% quality control in filter production.
Comparable to the manual filter scanner AFS 152, a hood option is offered for an exclusively integral measurement.

AFS 151 – Robot Filter Scanner

Integrating collaborative robot technology, the AFS 151 test system enables the scanning process for three-dimensional filter elements in accordance to ISO 29463-4. This innovative solution allows to scan planar filter elements, V-bank filters and filter cartridges. The robot can be set up for all conceivable 3D filter geometries within the maximum permissible working range. The required programming was developed and implemented in-house. A simple and fast integral hood measurement can also be realised in this test system.

- integral and local separation efficiency, leak detection
- filters up to (610 × 610) mm, (∅ 200 × 500) mm
- flow rate 1 ... 300 m^3/h
- modular instrumentation, aerosol generation and particle measurement
- test aerosol: DEHS, PSL

AFS 151 Robot Filter Scanner.

System control and software

Using the specially developed AFS15xWin test system software, all installed test system components and instruments can be monitored and controlled. Automatic test sequences enable the test routines to be carried out in a particularly time-efficient manner.

All measurement data is recorded and documented as raw data. The corresponding measurement results are clearly displayed. In the end, a standard-compliant report confirms the integrity of the tested filters. The integration into a customer database system is also possible.
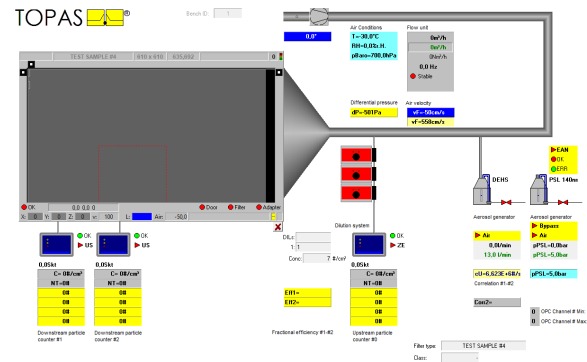
AFSWin: visualisation of the test system.

Various views can be selected for the visualisation of the measurement results. Further, the content of the report can be customised.
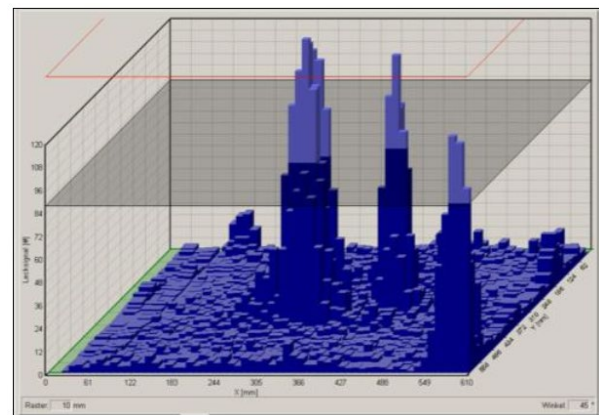
AFSWin: result display of leak detection.

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PARTICLE UNDER CONTROL