

Analytical Services Filter Performance Testing

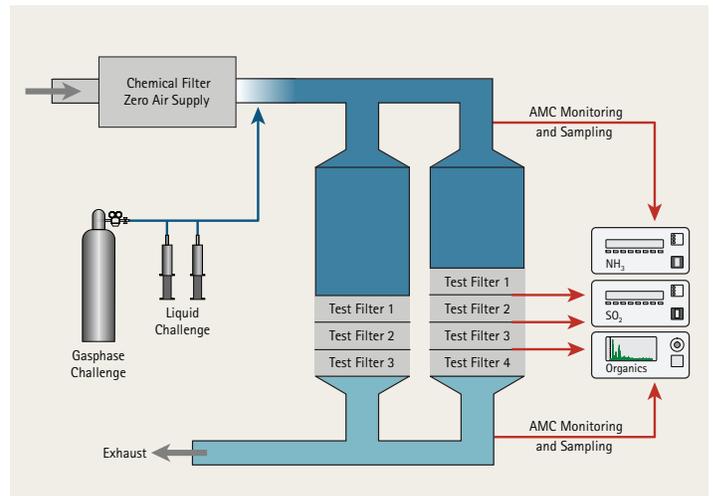
Evaluate and validate chemical filter performance

Entegris Analytical Services is the leader in the measurement of airborne molecular contamination (AMC) for semiconductor clean rooms, photolithography applications, and OEM compliance.

Based on more than 30 years of service and chemical filter development, Analytical Services is one of more than 30 Global Entegris Labs and provides state-of-the-art AMC analysis for high-technology environments to ensure confident operation of cleanroom, supply gases and materials.

APPLICATIONS

Following the “See It. Control It.” paradigm, Entegris Analytical Services naturally complements our market-leading chemical filtration and purification systems and a broad suite of products for comprehensive contamination control solutions. The service provides measurements for chemical filter performance testing and content extraction.



FEATURES & BENEFITS

State-of-the-art filter test facility

Capability to test a variety of standard and nonstandard filter configurations

Capability to vary flow, humidity and challenge concentrations for realistic filter evaluation

Scientific understanding of filter and AMC chemistry

OEM approved service

Accurate assessment of filter performance, including remaining filter capacity and/or postmortem analysis for filter lifetime extension programs

ISO/IEC 17025 accredited services—a competence standard for testing laboratories

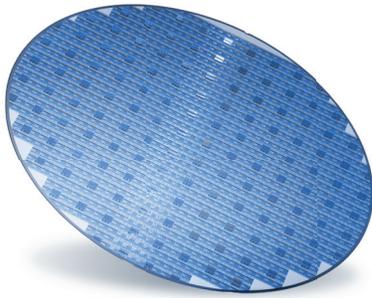


Confidence in data and detection limits

- Detection limits are statistically evaluated at 99% confidence
- Inter-laboratory comparisons and traceable standards ensure highest accuracy

Technical discussion and consultation available

Enables customized and most effective contamination control solutions



SPECIFICATIONS

| AMC CLASS | ANALYTES | SAMPLE TRAPS | ANALYTICAL METHOD |
|--|--|---|--|
| Acids/anions | Fluoride (F ⁻), chloride (Cl ⁻), bromide (Br ⁻), nitrate (NO ₃ ⁻), nitrite (NO ₂ ⁻), sulfate (SO ₄ ²⁻), sulfite (SO ₃ ²⁻), phosphate (PO ₄ ³⁻), acetate (CH ₃ COO ⁻), formate (HCOO ⁻) | DI water impingers or dry adsorbent traps | Ion chromatography (IC) SO ₂ – UV absorption online monitor |
| Bases/cations | Ammonium (NH ₄ ⁺ , NH ₃), amines (R ₃ N); Na ⁺ , K ⁺ , Li ⁺ , Ca ²⁺ , Mg ²⁺ can be provided on request | DI water impingers or dry adsorbent traps | Ion chromatography (IC) NH ₃ by CRD online monitor NH ₃ by chemiluminescence online monitor |
| Organics & refractory compounds¹ | Volatile and condensible organic compounds from IPA to C26, except volatile silicon containing compounds. | TruTOC™ Entegris traps | Gas chromatography/ mass spectrometry with automated thermal desorption (GC/MS-ATD) Toluene – online GC-PID Toluene by GCFID |
| LMW silicon | Low molecular weight (volatile) silicon compounds: TMS, HMDSO, D3 | Entegris proprietary traps | GCMS/liquid micro-extraction (LME) TMS and HMDSO by GC-FID |

Physical Specifications

| | | | |
|---------------------------------------|--|--|-----------------|
| Humidity, flow and temperature | H ₂ O, F, T | | Online monitors |
| Sample time | Continuous and as needed to achieve detection limits | | |
| Reporting limits | Depending on compound and method | | |

¹Refractory compounds are organic gases containing elements other than C, H, N and O; for example: Si, Al, B, P, S, F, Cl, Br, I, Fe, Sn.

Terminology

Postmortem tests are typically applied after the useful life of a filter has ended, but can also be applied during operation or for new filters. All postmortem filter tests are destructive, hence, filters can no longer be used for AMC removal applications after any one of these tests, and are usually discarded.

Removal efficiency (RE) is the percent of an upstream gas challenge that is removed by the filter at nominal flow rates (as recommended by the vendor).

Remaining capacity or lifetime is the calculated time that a filter would still be useful if it was operated at a given, constant (or average) gas challenge. The unit of RL is ppb-hours, a product of concentration and time.

Filters accumulate AMC on their adsorbents over time. Captured AMC content is the sum of all chemical compounds that have been captured by the filter over the course of its operating life.

Removal efficiency

Filter removal efficiency (RE) is defined as:

$$RE = \left(1 - \frac{[Downstream]}{[Upstream]} \right) \times 100$$

where [Upstream] and [Downstream] are the respective concentrations of the challenge gas upstream and downstream of the filter. The unit of RE is percent (%).

RE is tested by mounting the filter or filter stack in a high-flow wind tunnel and challenging it with a specific challenge gas or mixture of gases. Gases used at Entegris are sulfur dioxide (SO₂) as a proxy for acidic compounds, ammonia (NH₃) to represent basic compounds and toluene (C₇H₈) to represent organic compounds. Specialty compounds may be available upon request. Note that tests can only be combined for toluene and ammonia in most cases; tests for acid RE require a second filter or filter set.

Remaining lifetime/capacity

Remaining filter capacity or lifetime (RL) is estimated the same way as removal efficiency, except at higher concentrations to expedite the test. The test is carried out until removal efficiency drops below the filter specification or a customer-defined RE target. For scanner filters, for example, the RL test continues until the filter RE drops below 99%. For facility or tool-top filters, on the other hand, there is no pre-defined RE and the customer needs to determine how low the filter RE can drop to achieve a desired cleanroom AMC concentration. Such target RE values can range from 95% to 50% or less. Because of the lower RE target, and also for new filters, these tests can take several weeks.

Captured content

The compounds captured on a filter can be extracted (EX) from the filter using solvent extraction. This can show the distribution of AMC between individual filters, filter layers or across a filter stack and how different species slowly migrate through the filters at different speeds, depending on their volatility.

In addition, this AMC trapping concentrates compounds over time (the filter is a sample trap with very high capacity), which creates visibility for compounds that would normally be much below analytical detection limits. Together with the known, average flow rate and the runtime of these filters, an average concentration in the cleanroom can be calculated for the period of operation.

ORDERING INFORMATION

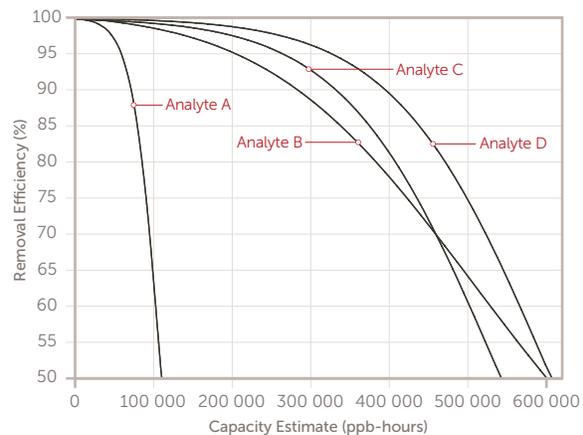
Filter test services

| Part number | Service | Comments |
|--------------|--|-------------------------|
| ESI005464-05 | Content extraction, 1 filter, bases | See analytes list |
| ESI005464-06 | Content extraction, 1 filter, acids | See analytes list |
| ESI005464-07 | Content extraction, 1 filter, organics | See analytes list |
| ESI005464-08 | Removal efficiency, 1 filter, ammonia (NH ₃) | |
| ESI005464-09 | Removal efficiency, 1 filter, sulfur dioxide (acids) | See analytes list |
| ESI005464-10 | Removal efficiency, 1 filter, organics (toluene) | See analytes list |
| ESI005464-11 | Remaining lifetime/capacity, 1 filter, ammonia (NH ₃) | Inquire about lead time |
| ESI005464-12 | Remaining lifetime/capacity, 1 filter, sulfur dioxide (SO ₂) | Inquire about lead time |
| ESI005464-13 | Remaining lifetime/capacity, 1 filter, organics (toluene) | Inquire about lead time |
| ESI005464-14 | Outgassing, 1 filter, per specified AMC class | Inquire about lead time |
| ESI005464-15 | Physical tests (specify), 1 filter, per test | Inquire about lead time |

Did You Know?

- OEM filter lifetime limitations may be extended by carrying out postmortem filter tests and regularly monitoring the associated cleanroom. See data sheets for OEM compliance sampling programs.
- Evaluation of removal efficiency and lifetime/capacity may require the entire stack of filters in the correct sequence and with inlet, outlet and flow direction clearly marked.
- Acids and bases, as well as acids and organics, cannot be tested for RE and RL at the same time and require two filters or filter sets.
- Lifetime tests can take up to several months. Please inquire about lead times.
- For postmortem filter tests, please ask your representative for RMA and procedure for labeling and packaging.
- Entegris tests filters at the lowest concentrations in the industry for the most realistic lifetimes. The higher the concentration, the more the lifetime gets inflated, a physical principle known as *adsorption isotherm*.

Typical performance curve of a chemical filter where removal efficiency starts out high and drops off over time



FOR MORE INFORMATION

Please call your Regional Customer Service Center today to learn what Entegris can do for you. Visit entegris.com and select the [Contact Us](#) link to find the customer service center nearest you.

TERMS AND CONDITIONS OF SALE

All purchases are subject to Entegris' Terms and Conditions of Sale. To view and print this information, visit entegris.com and select the [Terms & Conditions](#) link in the footer.



Corporate Headquarters

129 Concord Road
Billerica, MA 01821
USA

Customer Service

Tel +1 952 556 4181
Fax +1 952 556 8022
Toll Free 800 394 4083

Entegris®, the Entegris Rings Design®, and other product names are trademarks of Entegris, Inc. as listed on entegris.com/trademarks. All third-party product names, logos, and company names are trademarks or registered trademarks of their respective owners. Use of them does not imply any affiliation, sponsorship, or endorsement by the trademark owner.

©2010-2021 Entegris, Inc. | All rights reserved. | Printed in the USA | 1842-5886ENT-0921