AIR-O-CELL®

Bioaerosol Sampling Cassette

Laboratory & User Manual

Zefon INTERNATIONAL

Sampling Equipment Specialists

LA03040 Rev.2

Air-O-Cell® Sampling Cassette

The Air-O-Cell is a unique sampling cassette specifically designed for the rapid collection and quantitative analysis of a wide range of airborne aerosols. It collects both viable and non-viable particulate such as mold spores, pollen, insect parts, skin cell fragments, fibers (asbestos, fiberglass, cellulose, etc.) and inorganic particles.

Suggested & potential applications include but are not limited to the following:

APPLICATIONS

Indoor Air Quality: Mold spores, pollen, insect parts, dust mites, skin cell fragments, plant fragments, dust, fibers, combustion emissions, etc.
Home Inspection: Mold Contamination before of after real estate transactions.
Flood Restoration: Evaluation of mold spore contamination before, during, and after remediation.
Allergy Testing: Mold spores, pollen, insect parts, dust mites.
Clean Room Monitoring: Evaluation of low airborne dust and contaminants from personnel (skin cells, clothing fibers, cosmetics, etc.)
Fiber Analysis: Asbestos, fiberglass, cellulose, ceramics, etc.
Stack Emissions: Fly ash, inorganic dust, etc.

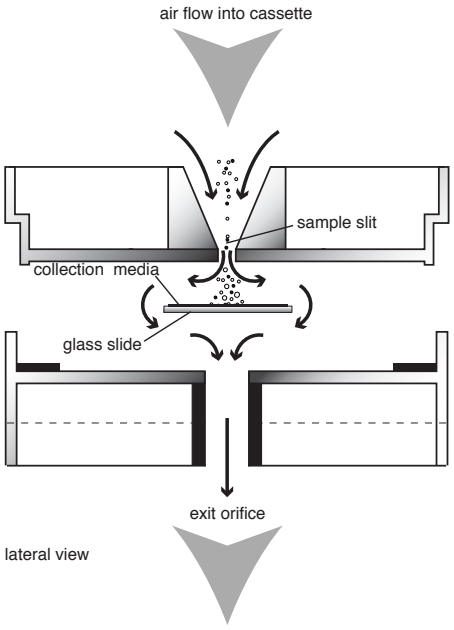
Air-O-Cell® ADVANTAGES

- Provides excellent detection limits over conventional filter sampling utilizing 25 mm or 37 mm diameter filter cassettes.
- Eliminates sample loss to cassette walls known to occur with filter samples from vibration or static charge during sampling and shipment.
- Eliminates the need for direct handling or preparation of collection media or microscope slides in the field.
- Eliminates potential cross-contamination between samples and during shipping that may occur with other devices.
- Unique optically transparent and smooth collection media allows direct staining and examination by bright field, dark field, and phase contrast microscopy!!
- The sampling media is compatible with a wide range of biological stains and refractive index oils allowing for direct quantitative analysis of biological and inorganic particles.
- The Air-O-Cell will work with virtually any kind of sampling pump capable of pulling a 15 lpm (vacuum) air flow.

PRINCIPLE OF OPERATION

The Air-O-Cell operates on the well established principle of inertial impaction. Particles in the air stream are accelerated as they approach the tapered inlet opening and drawn through a small slit aimed directly at a glass slide. This glass slide contains a sticky and optically clear sampling media which can permanently collect and hold particles. As the particles come through the slit, the air velocity forces the particles to impact into the sampling media, while the air stream makes a sharp 90° turn and proceeds around the slide and out of the cassette. The air flow path through the Air-O-Cell cassette is illustrated below in Figure 1.

Figure 1 **AIR FLOW PATH OF THE Air-O-Cell**



RECOMMENDED SAMPLING PROCEDURES

General:

The Air-O-Cell sampler is designed to operate at an optimal flow rate of 15 liters per minute. The user can employ any sampling pump capable of a minimum flow rate of 15 lpm. It is also capable of operating in any vertical or horizontal orientation, or in restricted access spaces smaller than 2 inches in diameter. As a result the Air-O-Cell is ideally suited for sampling in HVAC ducts, plenums, wall cavities, or other confined spaces.

Sampling of Ambient Static Environments:

A rotameter calibrated to a primary standard, soap bubble tube/meter or a dry bubble meter should be used to calibrate the sampling pump to a flow rate of 15 lpm. Some pumps only work with specific calibration devices. Please reference the owners manual for your pump to verify if any special calibration methods should be employed. Because the cassette does not produce significantly measurable back pressure, the rotameter can optionally be connected directly to the pump (without the Air-O-Cell cassette in line) to calibrate the pump flow rate.

To begin sampling, remove the tape seals covering the inlet and outlet and placed them on the side of the cassette. Then connect the Air-O-Cell cassette to the sampling pump using flexible tubing. Turn the sampling pump on for an appropriate sample time ranging from 1 to 10 minutes and both seals replaced after sampling is complete. Unlike other spore trap impaction or filter devices, the Air-O-Cell cassette can be oriented in any vertical or horizontal direction, without concern for sample loss of large particles or vibration. "Outdoor background" samples should always be collected for comparison purposes.

Sampling in HVAC Systems:

The Air-O-Cell cassette design allows for isokinetic sampling of aerosols in Heating, Ventilation and Air Conditioning (HVAC) Systems. Sampling can be conducted at the supply diffuser or inside most conventional ducts. The inlet of the cassette should always be facing into the flow stream. The inlet orifice has a cross-sectional area of approximately 11 mm x 15 mm (165.0 mm^2) tapering to a slit with dimensions of 1.055 mm x 14.4 mm (15.19 mm^2). The flow velocity can be increased up to 30 lpm with conventional sampling pumps, however, air flows exceeding 20 lpm may potentially damage some bioaerosols or cause "bounce off". Isokinetic sampling can be conducted in most air duct system with flow rates of up to approximately 600 fpm. Approximate face velocities for the Air-O-Cell cassette are given below for both the entrance orifice and slit exit in Table 1

Table 1

Air-O-Cell Theoretical Face Velocities

Flow Rate (lpm)	Orifice Face Velocity (fpm)	Orifice Face Velocity (mph)	Slit Face Velocity (fpm)	Slit Face Velocity (mph)
15.0	299	3.4	3110	35.3
20.0	399	4.5	4146	47.2
25.0	499	5.7	5183	59.0
28.3 (1 cubic ft.)	564	6.4	5867	66.8
30.0	598	6.8	6219	70.6

Recommended Sampling Time Intervals:

Although the Air-O-Cell cassette can provide excellent detection limits over conventional filter sampling utilizing 25 mm or 37 mm diameter filter cassettes, it is also sensitive to overloading. In an appropriately loaded sample, the trace should be barely visible and transparent, but not opaque or dense. If the sample appears highly visible or opaque, additional shorter time interval samples should be collected. The recommended sampling flow rate is 15 liters per minute (lpm). As mentioned above, flow rates exceeding 20 lpm have been known to cause "bounce off" of large particles such as pollen grains. Flow rates lower than 10 lpm will not collect the small mold spores (such as Aspergillus and Penicillium) as efficiently. Recommended sampling times (at 15 lpm) for different environmental sampling conditions are given in Table 2.

Table 2

RECOMMENDED SAMPLING INTERVALS

Environmental Dust Conditions	Sampling Time (minutes) 15 lpm
• Outdoor sampling on a clean windless day	10.0 - 60 min.
• "Clean" office environment or outdoors (no visible dust)	10.0 min.
• "Indoor" environment, high activity personnel	5.0 min.
• "Indoor" environment, evidence of drywall renovation, or industrial dust	1.0 min.
• "Indoor" environment, visible dust emissions from point sources present	0.5 min.

RECOMMENDED LABORATORY ANALYSIS PROCEDURES

Slide preparation

One to two (1-2) drops of staining or mounting media (lacto-phenol cotton blue is recommended for mold spore analysis) should be placed in the center of a clean pre-labeled slide. Air-O-Cell cassettes should only be opened in the laboratory. The sealing band should be cut, and the glass cover slip (containing the sample trace) removed and slowly placed on an angle with the media collection side down onto the staining solution. Do not press down on the slide during or after staining!. Excess staining solution should be removed from around the edges of the cover slip with a tissue wipe or cotton swab after 10 minutes has elapsed. This will ensure even staining of the sample. It should be noted that the slide can also optionally be mounted media side up. To do this, use a drop of fingernail polish to secure the Air-O-Cell slide to the microscope slide. Then place a couple drops of stain on the media and place a cover slip on top.

About Stains

Numerous stains may be used during laboratory analysis. These include lacto-phenol cotton blue, anline blue, calbreras stain and acid fusion stain. The most common stain used for mold spore analysis is lacto-phenol cotton blue.

To achieve the best clarity of the sample, using stains that have little or no water content is preferred. Water can cause the sample to appear cloudy.

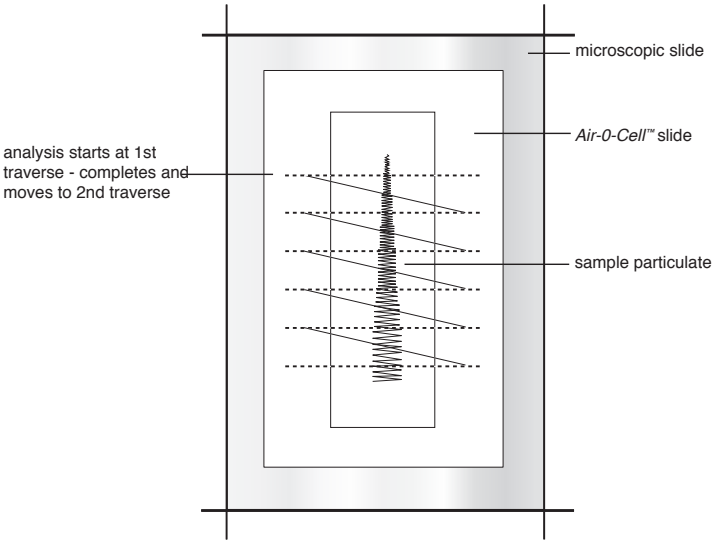
Microscopic Examination

Analysis of the collected sample should be performed by an experienced Microbiologist, Aerobiologist, Mycologist or Environmental Microscopist. Counting and quantification of sample components is conducted by counting calibrated cross-sections of the deposited sample trace. The number and type of particles counted per cubic meter of air is calculated based on the length of the deposition trace, length of trace actually examined, volume of air collected, and number of particles counted.

The Air-O-Cell particle deposition area at a flow rate of 15 lpm is approximately 1.1 mm wide by 14.5 mm long yielding an approximate area of 15.95 mm^2. The width of the deposition trace will vary slightly with flow rate and media thickness, and will vary slightly in particle density from the middle to outer edges of deposition. For this reason, using the deposition trace area is not recommended for direct calculation of particle concentrations. The recommended procedure for calculating particle concentrations is based on using the Air-O-Cell trace length and microscope field diameter, and will be discussed below. One field of view counted is defined as the calibrated diameter of the microscope field of view (in mm) covering one cross-sectional pass or "traverse" across the sample deposition trace. A typical sample preparation and microscopic counting procedure is illustrated in Figure 2.

Figure 2

ILLUSTRATION OF Air-O-Cell COUNTING METHOD



The calculation of particle concentration per cubic meter of air can be performed by using the following equations.

First, determine the actual air volume collected in cubic meters (m^3) by following the calculation given in Equation 1.

EQUATION 1:

Air volume (m^3) = (Sampling rate (liters per minute) / 1000) x Number of minutes

Second, determine the length of sample trace counted based on the microscope field of view and number of fields of view counted. Accurately calibrate and measure the diameter of the microscope field of view using a stage micrometer slide. Remember, each microscope is different, and each different combination of ocular and objective lens must be calibrated separately. Stated lens magnifications are rarely precise. The microscopist should then record the number of complete traverses examined across the width of the deposition trace and use the formula given in Equation 2 to calculate the actual length of the deposition trace examined.

EQUATION 2:

Trace Length Counted (mm^2) = Microscope field diameter (mm) x number of traverses

The concentrations of particles (cts/m^3) can then be determined by using Equation 3.

EQUATION 3:

$$\text{Cts} / m^3 = \frac{\text{Trace length (14.4 mm)}}{\text{Total length of trace counted (From Equation 2)}} \times \frac{1}{\text{Air Volume}(m^3) \text{ (From Equation 1)}} \times \#\ \text{of particle counts}$$

Two example calculations for mold spores and pollen grains are given below:

Example 1 Mold Spore Example

Microscope field diameter at (900X) = 0.240 mm
Number of traverses = 10
Sample volume (15 lpm @10 minutes) = (15 / 1000) x 10 = 0.150 m^3
Mold spore counts = 50

$$\frac{14.4\text{ mm}}{0.240 \times 10} \times \frac{1}{0.15} \times 50 = \frac{14.4}{0.36} \times 50 = 2000\text{ ct/m}^3$$

Example 2 Pollen Example

Microscope field diameter at (200X) = 1.11 mm
Number of traverses = 10
Sample volume (15 lpm @ 30 minutes) = (15 / 1000) x 30 = 0.450 m^3
Pollen counts = 25

$$\frac{14.4\text{ mm}}{1.11 \times 10} \times \frac{1}{0.45} \times 25 = \frac{14.4}{5.0} \times 25 = 72\text{ grains/m}^3$$

RECOMMENDED MICROSCOPIC COUNTING GUIDELINES

Counting & Identification Guidelines

Pollen — Entire trace or 100 grains (whichever comes first) should be examined at a minimum magnification of 200X. Identification and speciation should be performed at minimum magnification of 400X.

Mold Spores — A minimum of 15% of the entire trace should be examined or a minimum of 100 mold spores counted (whichever comes first). Identification and speciation should be performed at minimum magnification of 400X.

Fibers — The entire trace or 100 fibers, (whichever comes first) should be examined at a minimum magnification of 200X.

Other Aerosols — Skin cell fragments, combustion emissions, insect parts —A minimum of 10% of the entire trace should be examined or a minimum of 100 particles counted (whichever comes first).

Storage & Operating Conditions

This product should be stored at room temperature, between 60-82°F (15-28°C). Do not use product at temperatures below 32°F (0°C). If product has been exposed to freezing temperatures immediately before sampling, it is recommended to let the product acclimate to the sampling environment before use.

All bioaerosol samplers are not created equal and will not provide the same results. Look for this seal on your product as assurance of validated, industry proven performance and the highest quality product.

Ordering Information

Field Equipment

Product Number	Description
AOC010	Air-O-Cell® Cassettes, 10/box
AOC050	Air-O-Cell® Cassettes, 50/box
AOCWS10	Inner Wall Sampling Adapter, 10/box
AOC-CAL	In-Line Calibration Adapter
ZBP-307	Zefon Bio-Pump® Bubble Tube for Air-O-Cell
ZBP-200	Zefon Bio-Pump®
APB-803300	mini-Buck IAQ Calibrator
DCL-H	Bios DryCal® DC-Lite Calibrator

Laboratory Equipment

Product Number	Description
ZA0046	Cassette Opener
ZA0050	Particle Spreader, "T" shaped, sterile
ZA0051	Syringe, sterile, 3cc
ZA0052	Alcohol wipes, 200/bx
ZA0054	Forceps, self closing, each

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