

SASS[®] 2300

Smart Air Sampler System



INTRODUCTION

The SASS[®] 2300 (Smart Air Sampler System) is a portable multi-stage wetted-wall cyclone sampler that extracts particulates and water-soluble chemical vapors from air and transfers them to a liquid phase for later detection and analysis. It is highly automated and can be easily carried by a single person, and may operate unattended for extended time periods. This user-friendly sampler has been field-tested at a number of independent facilities and has been shown to possess excellent collection properties.

It is the only wet-type air sampler shown to efficiently collect virus-sized particles, and has been successfully used to detect the airborne viral pathogens that cause exotic Newcastle disease and hoof-and-mouth disease, as well as some strains of avian flu virus. Furthermore, it is the only portable sampler technology to receive U.S. Department of Homeland Security Certification under the U.S. Safety Act of 2002.

FEATURES

The SASS 2300 can collect both particulates and water-soluble chemical vapors from air. These materials are extracted from sampled air and trapped in a small volume of liquid that can be removed at any time for analysis. Distilled

water is typically the liquid of choice—no additives or surfactants are required for high efficiency. Trace aerosol concentrations can be amplified by extending the sampling time. A patented (US Patent No. 6,532,835) fluid monitoring system will maintain a fixed liquid volume in the device that is *independent of collection time, air temperature or relative humidity.*

The SASS 2300 draws air through a convenient threaded adapter on the exterior of the unit. This adapter allows the mounting of useful accessories such as flexible intake hoses and particle filters. A built-in peristaltic pump transfers liquid samples to an external analyzer for immediate analysis, or to a sample vial filling station integral to the unit. The filling station is convenient for dispensing all or a part of the liquid sample into a dropper bottle of the type used with lateral flow bioassay tickets.

The air sampler is microcontroller-based and can function as a stand-alone unit or connected to other sampling, detection or communication systems via RS-232 or wireless link. Purpose-designed software allows for particularly streamlined integration with Research International's RAPTOR[™] and BioHawk[®] biodetectors. The extensive use of microcontroller-based circuits allows overall system operating characteristics to be easily tailored to specific customer requirements. Reprogramming of sampler operation may be performed at any time over the RS-232 link without having to disassemble the unit.

Electric power consumption is minimized by operating the unit's blower at peak electric-to-pneumatic efficiency conditions and by using natural airflow through the cyclone structure to drive water recirculation. Weight and power consumption figures are far below other aerosol collection systems of comparable sophistication and collection efficiency, and may be further reduced for specialized applications such as unmanned air vehicle (UAV) applications.

OPERATING PRINCIPLES

A schematic representation of the SASS 2300 is shown in Figure 1. The cyclone has four main sections: a cyclonic cup, stripping column, cistern, and water feedback loop. A high-efficiency, battery-operated centrifugal blower at the cyclone exit pulls air through the unit. When turned on, the blower is activated and a water charge is injected into the cyclonic cup from an on-board fresh water reservoir. Incoming air enters at the cup perimeter, creating strong vortex action and a rapidly swirling film of water on exposed surfaces. The water film also passes across the air inlet region, forming a water curtain through which air must pass.

Concurrently, a centrally located nozzle projecting from the cup base injects additional water. This location is subject to high air shear and with proper nozzle design, fluid discharged from the nozzle into the cup will be in the form of a fine spray. The cup plays a major role in collection of sub-micron particles and molecular species due to the intimate two-phase contact provided, whereas larger respirable particles are captured in both the cup and a stripping column to be described.

The air stream then flows from the cup into a stripping column connected to the cup's upper surface. As air enters the smaller diameter stripping column it increases rotational velocity, enhancing particulate collection through centrifugal action. The inner surface of the stripping column is also wet by fluid outflow from the cup. The airflow rate and tube diameter have been selected so that adequate shear force is produced to create a cocurrent flow of water on the tube wall. The stripping column is operated beyond the so-called 'flooding limit,' meaning that liquid introduced at the base of the column cannot flow opposite to the upwelling air, and, in fact, must flow *up* the stripping column.

Water flows from the stripping column into a larger diameter cistern section located above the tube. Due to parasitic shear forces created by the rotating airflow, water transitioning from the tube to the cistern is flung outward to a water trap zone where a rapidly rotating water ring is formed. Water in the ring flows back to the cyclonic cup below by way of a liquid feedback tube. This water is re-injected into the cup via the spray nozzle, where it is once again available to collect additional particulates. Fluid recirculation rates have been measured to be in the range of 30 to 100 cc/minute. This means a typical 5 cc fluid inventory is recirculated through the unit from 6 to 20 times per minute.

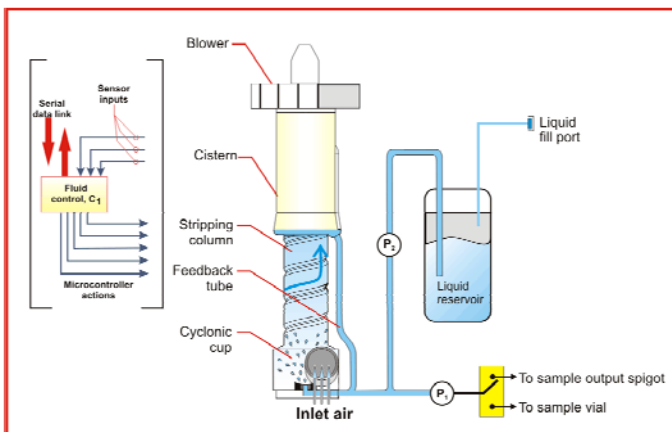


Figure 1: SASS 2300 fluid management system.

Fluid Control Subsystem

Liquid inventory is monitored with a proprietary sensor attached to the water feedback tube. Water inventories may be maintained within a recommended range of about 4 cc to 6 cc with an accuracy of a few tenths of a cc. Samples may be removed at any time, independent of ongoing air sampling using the onboard microcontroller-based peristaltic pump. A flow rate of approximately 12 cc/minute at a maximum delivery pressure of about 300 mmHg is provided. Design qualification tests have demonstrated a pump life in excess of 1000 hours. Pump power is a modest 300 mW at 12 V DC.

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SPECIFICATIONS	
Characteristic	Description
Operating principle	Multi-stage wetted-wall cyclone with enhanced particulate collection.
Air collection rate	390 LPM using 30,000 hr. life brushless fan.
Particulates collection range	1-10 µm. Contact Research International regarding vapor collection applications.
Concentration ratio	78,000/minute, nominal.
Liquid inventory	4-5 cc range, adjustable by user. Proprietary control loop maintains a constant liquid volume in the sampler, independent of collection time, temperature, or humidity; useful for concentrating trace airborne analytes.
Make-up water	1 liter on-board reservoir; supplemental off-board reservoirs may be used in fixed installations: 0.8 cc/min, typical evaporation rate at 20C/50% RH.
Physical size	18.4 cm x 21.3 cm x 34.3 cm (7.2" W x 8.4" D x 13.5" H).
Weight	3.7 kg without battery, 4.7 kg with battery (8.2/10.4 lbs). Add 1 kg (2.2 lbs) for 1 liter of water.
Air inlet	Industry-standard threaded adapter.
Humidity range	Non-condensing conditions.
Operating temperature	Above freezing conditions to 66° C.
Power source	BA-5590/U primary battery; or BA-5390/U extended life primary battery; or UBI 2590 rechargeable battery; or 82-265 Volt (47-63 Hz) AC lump-in-cord power supply.
Power consumption	1.33 amps @ 12 V, 16 W.
Sample extraction	On-board 12 cc/min peristaltic pump, manual or remotely controlled. Vial filling module included. Air sampling may continue during extraction.
System controls	Microprocessor controlled. RS-232 or optional wireless link for remote operation or reprogramming. Additional TTL and motor drivers available.
PC interface requirements	OS: Windows Server 2003/2008, Vista or XP. Processor: 400 MHz Pentium or equivalent (Min.). RAM: 96 MB (Min.), 256 MB (Recommended). Hard Disk: 1.2 MB available space. CD-ROM.
Sound level	60 dB (A).
Package	Lightweight two-piece molded plastic shell with swivel-style carrying handle.
Decontamination	Auto-flush protocol using onboard water, or manual flush with detergent and/or disinfectant. Disposable fan module.
Accessories	Carrying case; inlet hose; 8cc sample bottles; sample bottles; rechargeable battery and charger.
Approvals	U.S. Dept. of Homeland Security certified under U.S. Safety Act of 2002
<i>Research International reserves the right to change specifications without prior notice.</i>	