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***Specializing in All of Your Inhalation Toxicology Needs and More***

### **Turn-key Inhalation Exposure Systems for:**

- *Toxicology*
- *Pharmacology*
- *Biodefense*
- *Safety*
- *Infectious Diseases*



### **Aerosol Generators/Monitors**

- *Mono/Poly Disperse Aerosols*
- *Dust, Salt, Oil, Liquid, Carbon & Gas generators*
- *Nano Particle Instrumentation*
- *Particle Counters/Spectrometers*
- *Filter Test Systems*
- *Environmental Particulate Monitors*

### **Cigarette Smoke & E-cigarette Testing Equipment:**

- *30-Port Automatic Smoking Machines*
- *Single Cigarette Machines*
- *Automatic Smoke Control Systems*
- *Human Puff Profile Systems*



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## ***BANG: BioAerosol Nebulizing Generator***



- Based on Collison Nebulizer design
- Intended for nebulization of aqueous solutions of microorganisms or proteins
- Can be operated in single pass or recirculation mode
- The amount of solute delivered can be accurately metered
- Available in 1-jet, 3-jet and 6-jet models
- Offers a wide range of output
- Single pass or recirculating mode

The BioAerosol Nebulizing Generator (BANG) was developed by CH Technologies in collaboration with BGI, Waltham, MA. This low flow, low dead space generator works at a range of flows (i.e. 2 to 4 liters per minute with a pumped fluid or recirculated flow that features minimal sample utilization). The BANG takes into consideration the sensitivity of your agent through a design not found in other typical generators. This unique design increases the viability of your agent allowing improved delivery of the aerosol during acute or lengthy exposures.

Additional technology is available to regulate the fluid feed. This permits adjustment of the aerosol concentration without altering air flow. Other advanced technology features include mass-flow controllers for precise airflow control.

### **Application examples**

- Aerobiology
- Biodefense Research
- Aerosol Exposure Challenges
- Minimize Agent Use
- Ideal for Proteins, Bacteria & Microorganisms

### **Specifications**

**Particle diameter: approx. 0.7 to 2.5  $\mu$ m**

**Volume flow: 2 – 12 lpm**

**Models: 1-, 3- and 6-jet**

**Weight: approx. 2.3 kg**

## ***CenTAG: Centered-flow Tangential Aerosol Generator***



- Ability to produce larger particle aerosols of respirable size
- Aerosol concentrations can be controlled in real time
- Produces quasi mono-disperse aerosols
- Provides for improved survivability of bacteria
- Easy to operate and decontaminate
- Easy to maintain and simple to adjust

The CenTAG has potential to be used in bioaerosol studies since single pass systems are superior for the provision of exposures to live bacteria or viruses. Other traditional bioaerosol generators such as nebulizers or recirculating jet atomizers have a multitude of forces acting upon the individual particles in order to make them form an aerosol. Such generators impact liquid droplets containing cells against a wall or surface to form and refine the aerosol. This tends to severely damage, if not kill, many of the bacteria. The CenTAG has the potential to deliver a higher percentage of live bacteria at the animal breathing zone because the only force acting on the particles is the shear of the disk.

### **Application examples**

- Aerobiology
- Toxicology
- Inhalation Exposure
- Respiratory Drug Delivery
- Microbiology

### **Specifications**

**Particle Material:** Liquids

**Particle Diameter:** Tunable 3-11  $\mu\text{m}$

**GSD:** 1.2 to 1.6

**Air flow:** 2-50 lpm

**Liquid feed:** 2-100  $\mu\text{l}/\text{min}$

**Disk speed:** up to 70 k rpm

**Weight:** 7 lbs

## *Collison Nebulizer BGI by Mesa*

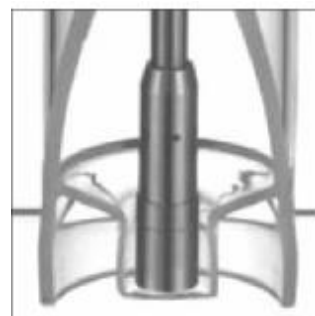


- Vertical or horizontal discharge
- Efficient aerosolization of various liquids
- Wide range of output
- Equipped with safe, shatter-resistant Polycarbonate jar
- Optional Precious Fluids jar
- Optional external fill adaptor
- Reproducible Standardized Performance characteristics

The Collison Nebulizer offered by CH Technologies was developed by BGI, Waltham, MA, now part of Mesa Labs, based on the original designs of the nebulizer that go back more than 50 years. The Collison Nebulizer, manufactured by Mesa Labs, has long been the recognized technique for the aerosolization of various liquids in a wide array of applications.

Suitable for use with precious liquids, these units are modified to use multiple jets (up to 24) which can be plugged by screws, to selectively control aerosol. The unit may be purchased in horizontal or vertical discharge models. Flange type connectors are standard, which allows attachment to extension tubes, vortex diluters, isokinetic sampling blocks and other innovative generation systems.

In this cutaway view the precious fluids well is visible. Total volume in this chamber is less than one milliliter. Since it is continuously fillable, there is minimal waste of precious fluids.



**CH Technologies is now the worldwide exclusive distributor of the Collison Nebulizer manufactured by Mesa Labs**

### **Application examples**

- Aerobiology
- Aerosol Research
- Biohazard Exposure Testing
- Consumer Products Testing
- Filter Evaluation

### **Specifications**

**Geometrical standard deviation:** < 1.5

**Volume flow:** 4 – 50 l/min

**Models:** 1-, 3-, 6- and 24jet

**Weight:** approx. 1.23 kg

## ***SLAG: Sparging Liquid Aerosol Generator***



- Low pressure bioaerosol generator specifically designed to handle sensitive microorganisms.
- Delivers highly viable bioaerosols (close to 100%)
- Allows for precise delivery
- Minimization of agent use
- Highly stable concentrations during prolonged exposures

The Sparging Liquid Aerosol Generator (SLAG) features a bursting bubble design that minimizes shear forces on particles being aerosolized. The particle suspension is typically delivered to the device via a peristaltic pump. The suspension travels downward through a narrow vertical needle and flows onto a porous stainless steel disk where it forms a thin-layered liquid film. The air is forced upward through the disk's pores into the liquid. The multiple air streams emanating from the porous disk break the suspension into bubbles where the particles are contained. An expanding pressure gradient between the inside and outside of the bubbles causes them to burst, thus aerosolizing the particles.

Particles and liquid not captured by the air stream are collected at the bottom of the vessel and play no further part in the aerosolization process. Thus, sensitive particles, such as microorganisms participate in the generation process only once and are not influenced by strong shear forces due to multiple jet cycles and recirculation.

### **Application examples**

- Aerobiology
- Biodefense Research
- Aerosol Exposure Challenges
- Ideal for Proteins, Bacteria & Microorganisms

### **Specifications**

**Particle diameter: approx. 0.4  $\mu\text{m}$  - 8  $\mu\text{m}$**

**Geometrical standard deviation: < 1,5**

**Volume flow: 2-16 L/min**

**Models: 0.75", 1" and 3"**



## ***BLAM: Blaustein Atomizer***



- Increased viability for vegetative bacteria aerosols
- Minimization of foaming when used with proteinic solutions
- Can be operated in both recirculation and one-pass mode
- Accurate control of liquid feed rate in one-pass mode
- Resistant to frequent decontamination procedures with chemicals or autoclaving
- Wide range of output
- Very high aerosolization efficiency
- Modular design, multi-use

The newly developed high output BLAM atomizer uses the jet nebulization principle of the Collison Nebulizer, which has long been the recognized as the technique for the efficient aerosolization of various liquids. However, the BLAM relies on a new, patent pending design, which allows for a more efficient generation of aerosol than the Collison or other existing devices, in both its single pass and recirculating configurations. This innovative design allows users to produce liquid aerosol at high particle concentrations and very narrow particle size distribution.

The BLAM can be used as a retrofit for existing Collison-type nebulizers. The retrofit kit is packaged as a direct nozzle replacement for many BGI by Mesa Collison nebulizers.

The BLAM can be used in one-pass mode, with the liquid feed being injected externally by a metering device, or re-circulation mode where the atomizer jar is pre-filled with the liquid test article and being cyclically atomized until is exhausted. A one-jet BLAM nozzle is intended to function for use in the Single Pass Atomization (SPA) mode where media is subjected to the sonic air jet only one time (single pass). The alternative design, a multi jet BLAM can function in SPA mode or Multi Pass Atomization (MPA) mode where media is recirculated to the two or more sonic velocity air jets.

### **Application examples**

- Aerobiology
- Biodefense Research
- Drug Discovery
- Aerosol Exposure Challenges
- Pesticides inhalation toxicity testing

### **Specifications**

**Particle diameter: approx. 0.4  $\mu$ m - 8  $\mu$ m**

**Geometrical standard deviation: ~ 1.4**

**Volume flow: 2-32 L/min**

**Models: 1-, 4- and 8 jet**

## *Palas Aerosol Generators for Liquids*



- AGK 2000
- AGF 2.0
- AGF 10.0
- MAG 3000
- PLG 1000
- PLG 2000
- PLG 2100
- PLG 2300
- UGF 2000

The Palas aerosol generators for the nebulization of liquids, solutions and suspensions are characterized by accurately defined, constant and reproducible particle size distributions and particle flows. The different products supply tailored aerosols for certain applications. The Palas aerosol generators for the nebulization of liquids, solutions and suspensions are characterized by accurately defined, constant and reproducible particle size distributions and particle flows. The different products supply tailored aerosols for certain applications.

Palas has specific generators that are designed to work with: salt solutions, nebulization of oils and other substances. There are generators specifically designed for use in HEPA and ULPA filter tests which generate particles at 40 nm at high flow rates. Others can generate particles at up to 8 µm in size.

### **Application examples**

- Clean room particle technology and validation
- Filter tests
- Quality control
- Oil mist generation
- Tracer particle generation
- Calibration of particle measurement devices
- Inhalation tests





## VAG: Vilnius Aerosol Generator



- Fluidized bed generator
- Produces wide range of aerosol outputs
- Ideal for handling small batches of powder
- Exceptional deagglomeration characteristics
- Double-headed model available for long operation time
- High stability of aerosol output; concentration controlled through an optical Casella aerosol monitor

The Vilnius Aerosol Generator (VAG) is a general-purpose dry powder disperser. The VAG is a highly useful device that produces aerosol concentrations from 1 to 2,500 mg/m<sup>3</sup>. In addition to its capability of producing high aerosol concentrations, the VAG provides exceptional deagglomeration characteristics.

The instrument consists of a Controller which is attached to a Dispenser unit. The Dispenser contains a dynamic aerosolization and a deagglomeration assembly. The aerosolization assembly includes a dust chamber for the placement of the powder to be aerosolized. The airflow is directed into the chamber through a control valve and a series of jets which impinge upon the powder dispersing it into the air. The aerosolization efficiency is increased by means of a vibrating cam that oscillates the turbine.

The aerosolization assembly is interconnected with the deagglomeration assembly by a capillary. The lower end of the capillary is positioned at the top of the dust chamber, while the upper end of the capillary enters the region of high velocity airflow. The aerosol particles are deagglomerated by the shear forces that are generated between the high velocity airflow that are exiting through a narrow gap around the capillary.

### Application examples

- Aerobiology
- Aerosol Research
- Aerosol Exposure Challenge
- Drug Development

### Specifications

**Particle size range:** < 0.1 µm - 100 µm

**Concentrations:** 1 – 2,500 mg/ m<sup>3</sup>

**Continuous Operation:** 0.5 – 6 hr

**Volumetric flow:** 4 – 10 L/min

**Weight:** approx. 1.8kg

## *Palas Aerosol Generators for Dry Powders*



- BEG 1000
- BEG 2000
- BEG 3000
- RBG 1000
- RBG 1000 D
- RBG 1000 I
- RBG 2000

Palas' line of solid particle generators has been used worldwide in a variety of fields of endeavor. This product line includes Rotating Brush Generators series (RBGs) and Belt Generator series (BEGs).

In an RBG, the powder to be dispersed is filled into a cylindrical powder reservoir and compressed uniformly along the filling height by a tamper. The powder column is pushed up against a rotating brush at an exactly controlled feed rate. An adjustable volume air flow streams over the tightly woven precision brush and lifts the particles off the brush. The particles are then deagglomerated by a high velocity air jet. RBGs are ideally suited for low to medium mass output requirements.

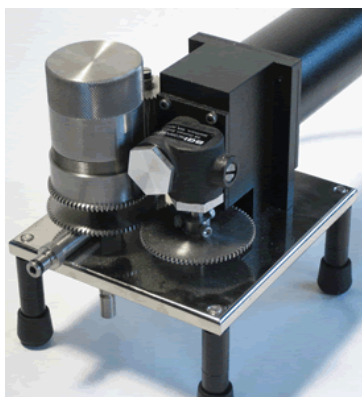
The BEGs use a conveyor belt to feed loose powder to a rotating brush. The powder to be dispersed is simply poured into the BEG reservoir. A stirrer at the bottom of the reservoir ensures constant loading of the conveyor belt. The desired mass flows can be adjusted continuously and reproducibly with a regulated drive of the conveyor belt. The BEGs are specifically design for applications that require medium to high mass outputs and continuous operation.

### **Application examples**

- Filter tests (e.g. compressed air filters)
- Loading of filters
- Inhalation Exposure Research
- Particle size analysis
- Tracer Particles
- Visualization of flows
- Calibration of particle measurement devices
- Calibration of CVS tunnels



## ***WDF II: Wright Dust Feeder II BGI by Mesa***



- Carbide cutter head technology
- Available smaller accessory mini-chamber for lower concentrations
- Superior consistency in output characteristics
- Wide output range
- All motor speed selectors are dual voltage and select automatically
- Exceptional deagglomeration characteristics

The Wright Dust Feeder has been available to research scientists for almost 60 years, since its development by Martin Wright. The current model, WDF II, is the result of significant improvements made to the original design over the years by BGI, now part of Mesa labs. BGI's contribution to the technology has been the standardization of stainless steel parts, the small and mini dust chamber, the development of the Venturi outlet for superior deagglomeration, the variable speed motor and the development of the carbide cutter head.

**CH Technologies is now the worldwide exclusive distributor of the WDF II manufactured by Mesa Labs**

### **Application examples**

- Basic Aerosol Research
- Filtration Studies
- Inhalation Research-Lung Physiology, Toxicology Therapy
- Pharmaceutical Aerosols
- Occupational Hygiene-Atmospheric Pollution
- Nuclear Science
- Calibration of Aerosol Samplers and Instruments
- Crop Research, Deposition Studies
- Meteorology

### **Specifications**

**Particle size range:** 0.1  $\mu\text{m}$  - 10  $\mu\text{m}$

**Output:** 0.0026 to 60.0 g/hr of unit density dust

**Volumetric flow:** 10 – 35 L/min

**Weight:** approx. 4 lbs

## *Palas Aerosol Generators for Nano-Particles*



- GFG 1000
- GFG 3000
- DNP 2000
- DNP 3000
- DSP 3010
- DSP 3000

Palas' line of nano particle generators has been used worldwide in a variety of fields where nano-size aerosol is needed. These generators are best suited for the generation of particles with an aerodynamic diameter of less than 0.5 micrometer.

The DNP & GFG Series generate the smallest particles of any of our generators. They utilize proprietary technologies to vaporize and, then, condense the test article starting from solid electrodes. Essentially, they take a high melting point solid and vaporize it, utilizing a high voltage. When the vapor cools nanoparticles form. DNP's use of nitrogen makes it ideal for inhalation studies or any study that requires the use of atmospheric air. Both DNP & GFG can be used to generate nanoparticles from graphite, metal and metal alloy electrodes.

The DSP Series manufactured by Palas GmbH is a large scale soot generator designed to simulate combustion products. DSP functions by combusting a fuel gas in the presence of air. Major features of the DSP Series include the ability to adjust the mean particle size of soot as well as the particle concentration. This is achieved by using a high-tech patented burner.

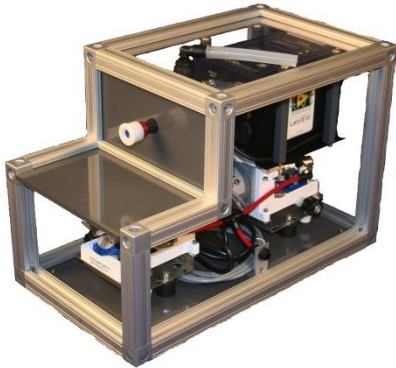
The DSP Series easily achieves the very high concentrations and mass flow rates required to test diesel soot filters in filter efficiency tests. Designed with safety in mind, the DSP Series is equipped with a comprehensive safety package.

### **Application examples**

- Filter tests (e.g. compressed air filters)
- Loading of filters
- Quality Control
- Particle size analysis
- Tracer Particles
- Visualization of flows
- Calibration of particle measurement devices
- Calibration of CVS tunnels



## *CSM-SCSM: Single Cigarette Smoking Machine*



- Manual cigarette smoking machine for analytical & toxicological studies
- Various protocols, regimens, cigarette sizes, & tests are supported
- Supports FTC, ISO 3308, and Canadian intense regime (CIR) puff profiles
- Side stream “Secondary Smoke” collection capability
- Labview Software allows for custom user defined automated protocols
- Supports combustible tobacco products and e-cigarettes
- High stability, servo controlled, downloadable profile data

The CSM - SCSM (Manual - Cigarette Smoking Machine) was designed specifically for the analytical and toxicological study of tobacco smoke and e-cigarette vapor. The CSM-SCSM uses a valve-free rotary piston technology to deliver an exact, repeatable puff profile. Its robust design allows for standard preprogrammed regimens, such as FTC, ISO 3308, and CIR, to be easily implemented.

User defined protocols are easily created by the touch of a button, allowing users full control of parameters such as, the puff length, draw rate, and idle burn time. Cigarettes are loaded and removed manually and lit with a typical butane igniter. The CSM-SCSM uses standard cigarette holders with labyrinth seals allowing a variety of cigarette shapes and sizes to be studied.

### **Application examples**

- Toxicology Research
- E-cigarette testing
- Inhalation Exposure
- Pharmaceutical Research

### **Specifications**

**Dimensions (in) (HWL):** 10 x 12 x 18

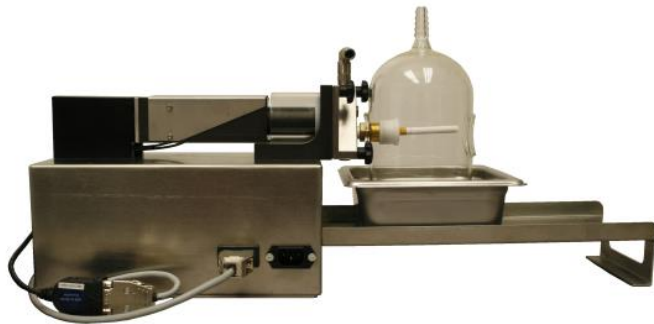
**Electrical:** 100 - 240 VAC, 47 - 63 Hz, 500 W

**Models:** Single Cigarette, Dual Cigarette

**Computer Requirements:** Windows XP, 7  
500 Mhz, RS-232/USB

**Weight:** approx. 25 lb

## *HPP: Human Puff Profile Smoking Machine*



- Able to draw puffs with volumes up to 200 ml
- Instantaneous speed variations are sufficiently large to allow duplication of extreme individual puff profiles with sharp slopes and dents
- Accurate reproducibility of human puff profiles
- Accurate emulation of standard smoking regimen
- Environmental smoke collection available
- Simple procedures to upload smoking profiles using Excel-based templates
- Portable and easy to maintain

Our Human Puff Profile Cigarette Smoking Machine (CSM-HPP) provides an extraordinarily versatile single cigarette smoking machine. It can be operated not only with standard smoking regimen, such as FTC, ISO, CIR, etc., but is also able to replicate real human puff profiles with great accuracy.

The CSM-HPP pump is equipped with a high speed Maxon motor which offers instantaneous speed variations sufficiently large to allow duplication of extreme individual puff profiles possessing sharp slopes and dents up to 200 ml puff volume. All parts in contact with smoke, including piston, cylinder and valves, can be removed for cleaning without tools.

The CSM-HPP can smoke a cigarette with up to 16 different puff profiles that perfectly mirror a smoker's recording. The way different individuals smoke cigarettes may have significant impact on the tar yield and the composition of the chemical mixture generated by the combustion process. The end results may also differ from those produced when the combustion processes emulate the standard smoking regimen. CSM-HPP constitutes a uniquely positioned research tool to explore these differences and their potential impact on health effects of cigarette smoke.

### **Application examples**

- Inhalation studies
- Toxicology Research
- Pharmaceutical Research
- Analytical studies

### **Specifications**

**Weight:** ~ 15 kg

**Dimensions (LWD, cm):** 55 x 87 x 115

**Smoking regimens:** FTC/ISO, CIR, MA+TX plus, and a variety of user defined protocols

**Models:** Single Cylinder, Double Cylinder

**Communication:** USB



## 30-Port Rotary Smoking Machine: JB 2090 Series



- Automatic Computer Control
- Automatic Ignition of Cigarettes
- Automatic Cigarette Ejection
- Compatible with a variety of puff profiles, including human puff profiles
- Staggered cigarette loading
- Can double as an analytical machine (with appropriate equipment added on)

CH Technologies' JB2090 offers a highly versatile cigarette smoking machine designed with significant flexibility so that it can be tailored to support a wide range of in-vivo and in-vitro exposure studies, as well as, cigarette smoke and e-cigarette analytical applications.

The JB2090 features fully automatic cigarette loading, lighting, smoking and ejection. JB2090 is the only rotary cigarette smoking machine in the market that is equipped with a rotating carousel that can smoke up to 30 cigarettes concomitantly according to standard smoking regimen or human puff profiles. This performance power makes it ideal for applications that require smoking of as little as one single cigarette up to large scale exposure studies requiring large volumetric flows of main stream and/or side stream cigarette smoke. The rotary head is designed according to ISO specifications and allows the user to load the cigarettes in a staggered pattern to achieve a more uniform burning around the carousel.

JB2090 is built in Switzerland with high quality materials and the renowned Swiss precision. Regardless of how non-standard the protocol required by your study, the standard JB2090 smoking machine can be equipped with the appropriate smoking pumps and specialized accessories to suit your needs.

### Application examples

- Inhalation studies
- Toxicology Research
- Pharmaceutical Research
- Analytical studies

### Specifications

**Smoking regimens:** FTC/ISO, CIR, MIR, and Human Puff Profiles  
**Loading:** Consecutive & Staggered  
**Number of Cigarettes:** 1-30  
**Cigarette Length:** 80-130 mm  
**Operating Air Pressure:** 80-100 psi  
**Ignition:** IR radiation  
**Weight:** ~ 150 kg  
**Dimensions (LWD, cm):** 55 x 87 x 115

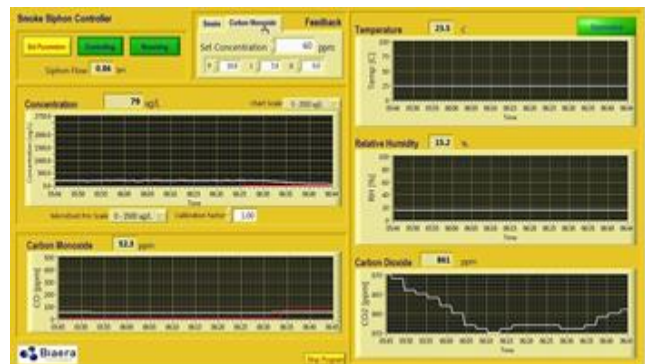
## Automatic Smoke Siphon



- Automated real-time aerosol concentration controller
- Easy to read screen allows quick access to all parameters from your PC
- Compact design enables use in tight spaces
- Computer controlled precision provides accurate and consistent results
- Push-to-connect fittings allow quick installation and cleaning
- Recording of smoke, CO, O<sub>2</sub> and CO<sub>2</sub> concentrations
- Monitoring and recording of environmental parameters

The CH Technologies Cigarette Smoke/Aerosol Concentration Control Siphon is a custom designed system for the automatic control of concentrations of cigarette smoke and aerosols used in inhalation exposure studies. Whether controlling the concentration directly at the outlet of the Siphon or at the exposure target (breathing zone or air-cell interface), the Siphon offers superb capabilities for an accurate control and consistent delivery of the required smoke exposure to test subjects. With few modifications, the Siphon can also be used for controlling e-cigarette vapor, aerosols or gaseous test atmospheres.

The concentrated main stream smoke coming from the smoking machine is mixed and diluted in a two-stage process with clean air and the resulting concentration is measured by a calibrated light scattering aerosol monitor. The desired concentration is set on the control software which uses the feedback from the aerosol monitor to control the delivery rate of the mixed smoke via a vacuum mass flow controller that siphons off small amounts of concentrated smoke to keep the output constant around the set point. A Siphon model for mixing in side stream in addition to main stream smoke is also available.



### Application examples

- In Vivo and In Vitro Cigarette Smoke Exposure Research
- Cigarette Smoke Analytical Studies
- E-cigarette Exposure and Analytical Studies
- Respiratory Drug Delivery

### Specifications

**Pre-dilution Flow Rate:** 0-10 lpm  
**Main Dilution Flow Rate:** 0-25 lpm  
**Siphon Flow Rate:** 0-10 lpm  
**Parameters:** TPM, CO, CO<sub>2</sub>, O<sub>2</sub>, T, RH%  
**Models:** Main Stream Only, Main Stream+Side Stream  
**Dimensions (in):** 21 x 21 x 12  
**Weight:** approx. 50 lbs

## *SCATR: Cigarette Smoke Control and Analysis Test Rig*



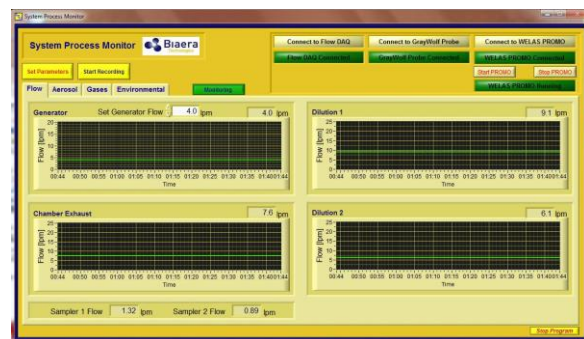
- Turn-key system for handling and characterization of cigarette smoke or e-cigarette vapor
- Automated real-time aerosol concentration controller
- Main stream / Side stream cigarette smoke mixer
- Built-in Side stream booster fan
- Computer controlled precision provides accurate and consistent results
- Modular design
- Monitoring and recording of smoke, CO, O<sub>2</sub> and CO<sub>2</sub> concentrations
- Monitoring and recording of environmental parameters

The CH Technologies Cigarette Smoke Control and Analysis Test Rig (SCATR) is a custom designed system for the mixing of main stream with side stream smoke, addition of dilution air, automatic control of smoke mix concentration, and characterization of TPM, gaseous components, and environmental conditions of the cigarette smoke test atmosphere that is used in large scale inhalation or in vitro exposure studies. With few modifications, the system can also be used for controlling and analyzing other aerosols or gaseous test atmospheres.

SCATR includes an automatic smoke siphon, a Promo aerosol spectrometer by Palas GmbH, a California Analytical Instruments gas analyzer and the Main stream / Side stream mixing system. All equipment is mounted on a standard 19" rack system, with easy access for operation and maintenance. The rig operation is controlled by a proprietary software that combines the functionalities and user-friendliness of our SPM and Siphon control software.

### Application examples

- In Vivo and In Vitro Cigarette Smoke Exposure Research
- Cigarette Smoke Analytical Studies
- E-cigarette Exposure and Analytical Studies
- Respiratory Drug Delivery



## *Modular BCU Whole Body Exposure Chambers*



- Modular, multi-cage chambers
- Lightweight
- Small footprint
- Chemical and heat resistant biocontainment cages
- Homogenous distribution of test atmosphere
- Patented airflow ventilation allows optimal air exchange rates
- Suitable for gasses, vapors, aerosols and mixed atmosphere exposures
- Provides exposure containment with negative or positive pressure operation

The CH Technologies Modular BCU Exposure Chamber is ideal for small-scale whole-body exposure studies. Each individual cage is composed of polysulfone to ensure the maximum resistance to chemicals and heat – this means that these chambers can withstand extreme cleaning cycles over their lifetime.

The cages accommodate up to 10 mice or 5 rats each. The cage design allows for optimal continual mixing of fresh test atmosphere. This minimizes the variation of exposure to each individual animal and leads to results that are more precise. The cages receive test atmosphere from appropriately designed 4, 6, or 9-port manifolds equipped with both a small mixing chamber and an attachment for any CH aerosol generator.

Sampling can be done on a per cage basis or over the entire system allowing researchers full access to the test atmosphere. Quick disconnect fittings allow for easy connection while providing extra security measures by way of their design. Negative pressure systems are also available allowing an additional level of safety if necessary.

The systems utilize custom-built mounting racks that hold up to nine BCU exposure cages. The flexibility this system provides allows for a wide range of test applications.

### **Application examples**

- Aerobiology
- Toxicology
- Immunology
- Microbiology

### **Specifications**

**Exposure capacity:** Mice – up to 5  
Rats – up to 10  
**Cage Volume:** 25 liters  
**Nominal Flow Rate:** ~4 lpm per cage  
**Weight:** 15 - 100 lbs  
**Cage Dimensions (LWD, in):** 12 x 12 x 18  
**No. of Cages:** from 1 to 9  
**Material:** Cages – polycarbonate  
Rack - Aluminum

## *Hazleton Whole-Body Exposure Chambers*



- Cage units can be mixed and matched to accommodate a variety of animal sizes.
- Hamster, guinea pig, rabbit, and non-human primate caging is available.
- Excellent performance with full or partial animal loading.
- Suitable for gasses, vapors, aerosols and mixed atmosphere exposures.
- Chambers are mobile and the 32" wide Hazleton 1000 will fit through a standard laboratory door
- Ideal for sub-chronic and chronic exposure studies
- Reduces handling and animal care costs by combining animal exposure and housing into one unit.
- Fabricated from glass and stainless steel components with silicon seals that are all cage washer compatible.

CH Technologies offers Lab Products H-750, H-1000 and H-2000 whole-body inhalation exposure chambers for accommodating large numbers of animals of various species.

The H-1000, with an internal volume of approximately 1 m<sup>3</sup>, has the capacity for up to three individual stainless steel mesh cage units. The H-2000 with an internal volume of approximately 2 m<sup>3</sup> has the capacity for up to six individual cage units. Each cage unit is divided into a number of individual animal compartments depending on the size of the animals.

Hazleton chambers are designed for uniform mixing of exposure atmosphere while protecting each level of animals from the excreta of animals on other levels. The castor mounted chambers are mobile and designed for efficient set-up and tear-down and they are cage washer compatible. Each cage unit comes with an automatic watering system and removable food tray. This, along with readily serviceable excreta pans, allows for continued use of the chamber as animal housing during off-exposure periods.

### **Application examples**

- Sub-chronic and chronic exposure studies
- Animal housing
- Cigarette smoke studies
- Uninterrupted exposures

### **Specifications**

**Exposure capacity:** Mice – up to 360

Rats – up to 144

**Chamber Volume:** 0.75, 1 and 2 m<sup>3</sup>

**Species:** mouse, rat, guinea pig, hamster, rabbit, non-human primates

**No. of cages:** from 1 to 6

**Material:** Stainless steel



## ***NOIES: Nose-Only Inhalation Exposure Systems***



- Modular design allows for increased expandability
- Precise self-centering design
- Easy connection to a large variety of aerosol generators
- Test article fed from the bottom up
- Minimizes re-breathing
- Accommodate multiple varieties of species
- Aluminum or Stainless Steel design
- Operated under positive or negative pressure
- Can be used in any containment up to BSL4

CH Technologies inhalation systems allow direct, nose only exposure of a test aerosol to a number of animals simultaneously. Through the patented aerosol delivery system, a homogenous distribution of the aerosol is achieved. These systems have a modular design, which mean the only limiting factor to the size of tests is the space available to test in.

The NOIES family of devices includes exposure systems for single animal, two to five animal exposure, and tiered modular systems (stackable) for 12, 16 and 18 test subjects per tier. While rats and mice are most often the subjects of Oro-Nasal Aerosol Respiratory Exposure Systems (ONARES) applications, the ONARES technologies for restraint and compound delivery as a size selected aerosol, a gas or a dust/powder can be applied to ferrets, rabbits as well as primates.

The NOIES has delivered consistent and validated results over a wide range of aerosols in all facets of research. Aerosol is generated at the bottom of the tower and directed straight to the nose of the animal. After the aerosol is delivered, exhaust air is immediately vented through the outer plenum and top of the tower minimizing any rebreathing by the animal. Easy maintenance, dependable results, and industry tested design are just a few reasons CH Technologies' exposure systems are found throughout some of the most prestigious research facilities worldwide.

### **Application examples**

- Inhalation exposure studies
- Pesticide research
- Drug development
- Cigarette smoke studies
- Infectious disease studies
- Highly toxic agent studies

### **Specifications**

**Modular Tier Capacity:** 12, 16 and 18 animals

**Non-Modular:** from 1 to 5 animals

**Species:** mouse, rat, Guinea pig, rabbit, ferret

**No. of Tiers:** up to 12

**Material:** Stainless steel or Aluminum

**O-rings:** silicon or Viton



## *Nose-Only Exposure Animal Restrainers*



- Available in open and closed varieties
- Range of sizes to accommodate multiple ages and species
- Quick loading push button restraint lock
- Industry Standard Port Size
- Chemical and temperature resistant

Animal Restraining Tubes are available for a multitude of rodent species (Mice, Rats, Guinea Pigs, Ferrets, Hamsters and Rabbits) in a variety of sizes and designations (open & closed), as well as masks and restrainers for canines and non-human primates

CHT also offers a variety of Plethysmographs for mice, rats, Guinea pigs, ferrets and rabbits that are modified versions of our standard nose-only restrainers. They can be used in conjunction with appropriate pulmonary measurements systems to monitor animals' pulmonary functions during nose-only inhalation exposure studies.

### Available Varieties

**CHT 247:** Open, Closed  
**CHT 249:** Open, Closed  
**CHT 250:** Open  
**CHT 2500:** Open, Closed  
**CHT XXL:** Open, Closed  
**CHT Rabbit:** Closed  
**CHT Ferret:** Open, Closed



Specifications	CHT 247	CHT 249	CHT 250	CHT 2500	CHXXL
<b>Weight Range (g)</b>	20 - 25	150-300	250-350	400-750	750-1000
<b>Length (in)</b>	5.375	9.375	10.375	10.375	12.4
<b>Height (in)</b>	1.05	2.75	3.25	3.5	4
<b>ID (in)</b>	0.875	2.45	2.875	3.25	3.625
<b>OD (in)</b>	1.05	2.75	3.25	3.5	4

## *Palas Aerosol Spectrometers*



- Welas digital 1000
- Welas digital 2000
- Welas digital 3000
- Promo 2000
- Promo 3000
- Inas

Aerosol Spectrometers made by Palas all utilize white light to give the most accurate representation of a large size distribution of aerosol. They are capable of accurately sensing particles as small as 120 nm up to 100  $\mu\text{m}$ , with minimal coincidence and boarder zone error.

These spectrometers can measure particles in a wide temperature range (-120° - 470 °C) and up 10 bar of back pressure. Measurements can be made at intervals as small as 10 milliseconds. Using fiber optic cables, Welas® sensors – equipped with measurement volumes of varying sizes – can be easily attached to the Welas® digital 2000 and 3000 and exchanged at will. These sensors make possible a reliable measurement in the concentration range from less than 1  $\text{P}/\text{cm}^3$  to 100  $\text{P}/\text{cm}^3$ . The sensors are available for measurements in gases as well as in liquids. These devices can also function safely in laboratory (BSL III and IV), explosive, and corrosive environments.

### **Application examples**

- Quality control / filter test
- Inhalation aerosols
- Process optimization
- In-situ measurements
- Droplet size spectrum
- Particle size analysis
- Characterization of test ducts and test aerosols
- Cloud research



## 47 mm Gravimetric Sampler



- Light weight anodized Aluminum construction
- Eliminates internal and external leakage problems
- Furnished with custom connectors
- Finely etched stainless steel filter pad support
- Homogeneous material collection

The 47mm Filter Holder has been the standard general purpose filter unit for a wide variety of scientific sampling applications for over 40 years. This design originated in the air filtration research department of a major university and has been the quality standard for this type of device since 1962.

The key to this device is the application of the overlapping seal principle combined with a very open pore, etched stainless steel screen. The conical shape of the outlet allows for the more homogeneous distribution of the collected material on filter pad, thus avoiding overloading at the center.

The 25mm and 37mm Filter Holders were developed to meet constant requests for these other two standard sizes. The overlapping seal principle has been retained. While the 47mm models have always been threaded ¼ inch NPT, the 25 and 37 mm models use ⅜ inch NPT.

### Application examples

- Toxicology
- Inhalation Exposure
- Duct Sampling
- Occupational Hygiene

### Specifications

**Diameter (in) :** 2.37

**Weight :** 8.5 oz

**Material:** Anodized Aluminum

**Connectors:** ¼" NPT thread

## *SSTI: Stainless Steel and Teflon Impinger*



- Teflon material provides additional level of security
- Low sampling flow rate increases viability of organisms
- Improved spray-factors for inhalation exposures
- 316 Stainless Steel and Teflon Material
- Equivalent to AGI
- Built-in exhaust filtration

The Stainless Steel & Teflon Impinger is designed for collection of microorganisms in all facets of research. The improved low flow design has been proven to increase the viability of cells during collection. CH Technologies SSTI has been shown to reduce particle bounce and overloading, thereby limiting re-aerosolization of the organism.

The Impinger is designed to provide improvements in efficient sample collection, while providing increased safety for researchers. As with traditional samplers, particle sizes collected may be affected by flow rates. The SSTI's low flow rate (0.5 L/min) provides optimal collection for biological samples.

### **Application examples**

- Aerobiology
- Toxicology
- Immunology
- Microbiology

### **Specifications**

**Collection Volume:** 50 cc

**Height (in) :** 10

**Weight:** approx. 0.5 lb

**Material :** Body - Teflon  
Stem - 316 Stainless Steel

## 7-Stage Cascade Impactor



- Industry standard
- Low flow sampling
- Low pressure drop
- Simplicity of operation
- High reliability and predictability
- Suitable for dry powders and low volatility liquids
- Low maintenance

The CH Technologies Mercer-style Cascade Impactor, manufactured by Intox Products, is a seven-stage aerosol sampler used for aerodynamic particle size distribution measurements. Cascade impactors have been in use for over 60 years with an inherent simplicity and predictability that makes them the standard by which other methods are compared. Each Mercer-style Cascade Impactor is precision engineered and fabricated to provide the sharpest particle size cut-off efficiency curves available in the respirable range.

Our Mercer Impactor is designed to sample at low air flow rates, between 0.5-1 lpm, making it ideal for inhalation exposure applications where the test article is dispensed at low volumetric flows. During operation, aerosol is drawn through a series of successively smaller jet openings and impacted on collection surfaces (impaction plates). The aerosol mass collected on each stage is then gravimetrically determined. The results are analyzed by plotting the data on log probability graph paper or by using a computer program to determine the Mass Median Aerodynamic Diameter (MMAD) and Geometric Standard Deviation (GSD) of the aerosol sampled.

### Application examples

- Inhalation studies
- Environmental measurements
- Aerosol research

### Specifications

**Nominal Flow Rate:** 0.75 lpm

**Nominal Size Cuts:** 0.4  $\mu\text{m}$  – 5.4  $\mu\text{m}$

**Dimensions (in) :** 6 L x 1 D

**Weight:** approx. 0.5 lb

**Pressure Drop:** 1.5 psi

**Material :** 316 Stainless Steel

## *Palas Nanoparticle Measurement Equipment*



- U-SMPS
- Charme
- DEMC
- UF-CPC

CH Technologies offers a variety of systems, manufactured by Palas GmbH, to measure and count the smallest of measurable airborne particles. CH products suited to this category offer a method to scan the size distribution of an aerosol and a variety of technologies to count the number of particles present.

These systems rely on Palas' innovative solutions that give our products a distinct superior quality and durability. Palas' nanoparticle measurement systems use the same advanced detection technology employed in their spectrophotometers that delivers accurate measurements without border zone errors and very low coincidence.

For the nanoparticle measurement systems, this means maximum reliability and increased flexibility for the user in determining the particle number (UF-CPC, Charme) and the particle size (U-SMPS). Special care is taken to ensure easy handling of the devices through intuitive graphical user interfaces and touchscreen based software. The components of our nanoparticle measurement systems can be easily interfaced and integrated with components from other manufacturers.

### **Application examples**

- Aerosol research
- Indoor and outdoor particle measurement
- Workplace measurement
- Test of filters and air cleaners
- Cloud research
- Emissions measurements
- Inhalation measurement
- Calibration





## LabFlow Manual Control Units



- Manual control of air inputs
- Simple to operate and maintain
- Redundant safety features
- Small footprint and lightweight
- Highly accurate flow controls
- Reliable and cost efficient

The CH Technologies LabFlow control unit series offers a wide selection of controls to be mated with the inhalation system of your choice. They are the perfect choice for users that are looking for simple and reliable manual methods to control their inhalation exposures. Our LabFlow control units are equipped with state-of-the-art digital, highly accurate and standard-traceable air flow controllers. With their lightweight aluminum boxes and remarkably small footprint, LabFlow units are ideal for use in cramped spaces. Although they are designed specifically to control CH Technologies inhalation systems, LabFlow units can be used for other non-related laboratory air flow control applications.

Users operating positive pressure systems can choose between the basic and cost-effective LabFlow C II, which offers just the core control functions, and the standard LabFlow P II which affords the user the full package of system parameter control and added safety features.

On the high-end of the LabFlow series is the LabFlow V II negative pressure control unit, which is the unit of choice of all our exposure systems used for bioaerosols, infectious diseases and other highly toxic test articles. LabFlow V II is loaded with sophisticated safety features that are paramount for these type of systems, the most important among them being the automatic control of inhalation chamber pressure and outflow. System exhaust is captured and test article residuals removed in a two-stage filtration process. Labflow V II is designed with optional data acquisition and transmission capabilities which, coupled with CH Technologies' System Process Monitoring software, can be used for supporting and compliance with GLP requirements.

### Application examples

- Positive pressure systems
- Negative pressure systems
- Other stand-alone air flow control applications

### Specifications

**Aerosol Generator Flow Rate:** 0-20 lpm

**Dilution Air Flow Rate:** 0-25 lpm

**Sampling Line Flow Rate :** 0-10 lpm

**Air Pressure:** 0-100 psi

**Vacuum:** -30/0 in Hg

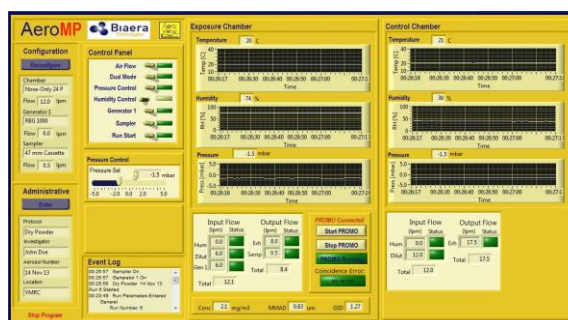
**Dimensions:** 10"L x 6"W x 7"H

## Biaera AeroMP Automatic Control Unit



- Integrated monitoring and fully computerized control of all inhalation exposure system components
- Highest safety standards in inhalation exposure operations
- Remote control capabilities
- User-defined inhalation system performance parameters
- Comprehensive data recording and event logging to document and archive component functions
- Fully compatible GLP procedures and controls

For experiments with zero tolerance for error in safety, data acquisition, or procedure, CH Technologies offers the AeroMP manufactured by trusted CH partner Biaera Technologies. The AeroMP software allows the user to simultaneously monitor and control the various functions while the component interdependence is being managed through the computer hardware and software. The result is a reliable, flexible, easy to use system that produces a single data stream which facilitates rapid analysis of experimental outcomes, tracking experimental performance over time and direct comparisons between individual components of individual experiments.



AeroMP serves as an ideal tool for those looking to increase the efficiency of their inhalation system operation. It is the perfect choice for organizations that are required to have a high degree of sophistication in their data acquisition, processing and reporting procedures, especially for GLP compliance.

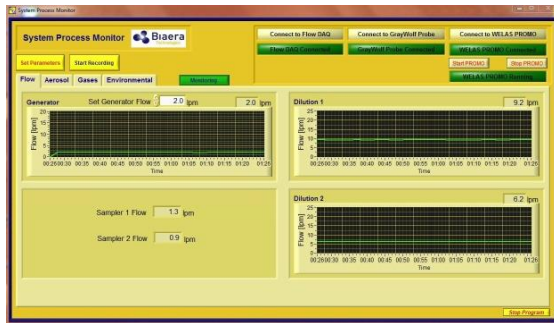
### Application examples

- Research conducted in BSLIII and IV Environment
- Infectious disease research
- GLP compliant experiments
- Aerobiology and biodefense

### Specifications

**Total System Flow Rate (input & exhaust):** 0-30 lpm  
**Aerosol Generator Flow Rate:** 0-30 lpm  
**Sampling Line Flow Rate :** 0-5 lpm  
**Air Pressure:** 0-100 psi  
**Vacuum:** -30/0 in Hg  
**Balancing Method:** automatic or manual increment  
**Chamber humidity:** 5% to 95 %  
**Chamber operating pressure:** -5 to +5 mbar  
**Exposure duration:** user defined  
**Chamber exhaust:** automatic or manual stop  
**Dimensions:** 12”L x 20”W x 10”H

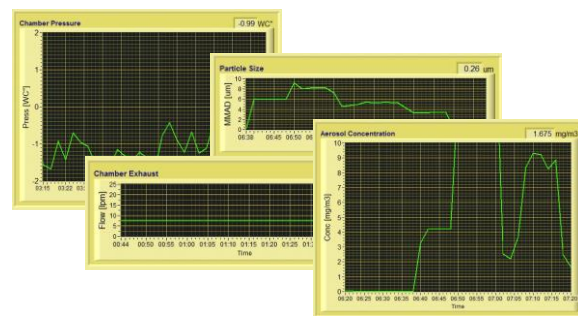
## System Process Monitoring Software



- Integrated monitoring of all exposure parameters
- Stand-alone Labview application
- Selective connection to all devices that provide the data
- Processes digital data streams and analog signals
- GLP compliant recording protocols
- Intuitive and easy to use user graphic interface

The System Process Monitor (SPM) is a data acquisition software that has been specifically developed for monitoring and recording of parameters of CH Technologies inhalation exposure systems. The software collects and integrates data from various system control and monitoring devices, either in digital or analog format. The recorded data are stored in the form of a time series and exported into a text file.

The software is written and runs in a Labview environment. System parameters are bundled into four groups (Flow, Aerosol, Gases and Environmental) which could be accessed on the screen by simply clicking on the respective tabs.



The SPM is designed to acquire data selectively from the LabFlow V II control unit and monitoring devices used in conjunction with our inhalation systems. The SPM is the perfect tool for users that require GLP compliance for their inhalation systems.

### Application examples

- GLP compliant experiments
- Aerobiology and biodefense

### Specifications

**Flow parameters:** Aerosol generator  
Dilution Air 1 Flow  
Dilution Air 2 Flow  
Chamber Exhaust  
Sampling Line 1  
Sampling Line 2

**Aerosol:** Mass concentration, MMAD, GSD

**Gases:** CO<sub>2</sub>, O<sub>2</sub>, VOC, CO concentrations (other gases avail)

**Environmental:** Chamber pressure, T, RH

## *Palas Fine Dust Monitor Systems*



- Fidas Mobile
- Fidas 100
- Fidas 200
- Fidas 300
- Dustview II

The Fidas systems are fine dust measuring devices with a high time resolution, for continuous measurements of PM<sub>1</sub>, PM<sub>2.5</sub>, PM<sub>4</sub>, PM<sub>10</sub>, TSP (PM<sub>tot</sub>) and the particle number concentration in the environment.

On the other hand, the fully automated dust measuring device DustView II provides a fast and accurate measurement of even smallest dusty particulates, which are released after the free fall and impact of dry powder material in workplaces.

All Fidas systems, as well as DustView II, use the well-recognized measuring technology of optical light scattering and are equipped with a white light LED source with high light stability and high light intensity, yet low energy consumption and a longer service life. If desired the particle size distribution can be viewed for any point in time. If desired, the particle size distribution can be viewed for any point in time of the measurement.

Fidas systems have been recently certified in Europe as equivalent method for compliance monitoring of ambient PM<sub>10</sub> and PM<sub>2.5</sub>.

### **Application examples**

- Environmental monitoring in networks
- Immission
- Long-term studies
- Source apportionment
- Propagation and distribution studies
- Indoor pollution measurements
- Workplace exposure monitoring



## *Palas Filter and Filter Media Test Systems*



- MFP 1000
- MFP 2000
- MPF Nanoplus
- MFP 3000
- HFP 2000
- MMTC 2000 EHF
- MMTC 2000
- MMTC 3000
- MMTC 1000

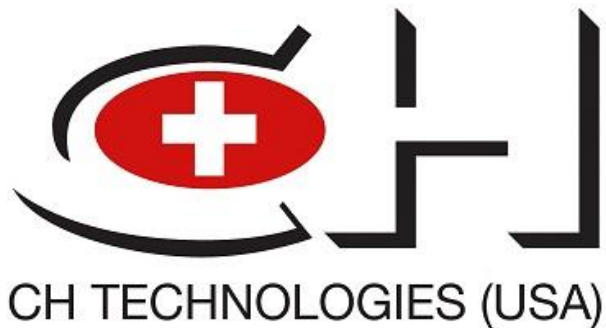
CH Technologies offers to its customers complete test systems and components, manufactured by Palas GmbH, for the development and characterization of filter media. With filter tests it is essential that the assessments can be accomplished quickly and that they are reproducible. The filter test systems are built at Palas not only in accordance with standards, but also customized to meet customer's specific requirements.

For more than 25 years, Palas has been building complete filter test systems for filters and filter media to industry standards. Palas also offers upgrades of existing test rigs, including their components for the particle generation (aerosol generators for droplets, salts and solid particles) and for the particle measurement (aerosol spectrometers).

### **Application examples**

- Car interior filters
- Engine filters
- Cleanable filters
- Hot gas filters
- Vacuum cleaner filters
- Room air filters
- HEPA/ULPA filters
- Respiratory filters
- Diesel soot filters
- Oil separators
- Compressed air filters





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## **SERVICES**

**Standard and Custom System Designs for Positive and Negative Pressure Exposure Systems**

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**Custom Design of Systems with Automation Hardware /Software**

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