FLOW SCIENCES, INC.

TALC & CARBON BLACK NANO PARTICLE PROCESSING

- Black Polypropylene Construction
- Talc and Carbon Black Nano Particle Transfer

NANOTECHNOLOGY

ENCLOSURES DESIGNED FOR THE MANIPULATION AND MANUFACTURE OF NANOMATERIALS FOR USE IN RESEARCH AND MANUFACTURING ENVIRONMENTS.

CONTAINED VENTED ENCLOSURE

NanoSafe Tested™

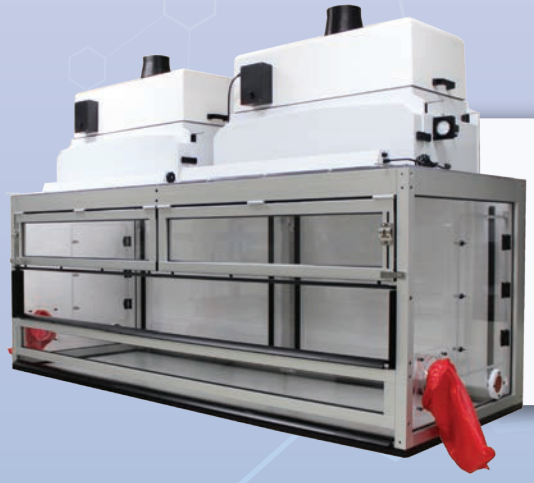
- Available in Various Sizes

NANOTECHNOLOGY SUITE

- Polypropylene Construction
- Integrated Powder to Chemical Nano-Process
- Custom Multi-Phase Energy Technology Production Design

CARBON NANO TUBE WEIGHING ENCLOSURE

- Black Polypropylene Construction
- Designed for Weighing and Processing Carbon Nano Tubes
- 98”w x 33”d x 61”h



CARVER PRESS AND RPA CUTTER NANO PROCESSING ENCLOSURE

- Aluminum Framed Construction
- Balance, Cutter, and Hydraulic Press Curer Nano Application
- 100”w x 40”d x 36”h

Nanotechnology is a dynamic science producing new materials and products with extraordinary applications in medicine, energy, aeronautics, and the environment. However, there is little regulation governing this science, specifically with regard to personnel and environmental exposure risks.

Nanoparticles exhibit different and varying levels of toxicity, chemical, and physical properties in comparison to their macroscale. For these reasons alone researchers must protect their breathing zones and implement sound risk assessment and risk management strategy by investing in safety containment solutions.

Environmental Health and Safety

Organizations and universities are now administering nano-specific EHS programs including training and monitoring the work environment which translates to concerns for nano-researcher safety. The specific safety protocols are contingent upon nanomaterial life cycle stages, modifications, and disposal. Containment is necessary because nanotechnology presents vast challenges for environmental monitoring and minimizing harmful contaminants in the laboratory and workplace.

"A fundamental requirement for assessing the potential impacts of new nanomaterials on both human health and environment is the ability to make precise, accurate measurements at the nanoscale in multiple, complex media." (Strategy For Nanotechnology-Related Environmental, Health, and Safety Research; NNI pp12; 2008)

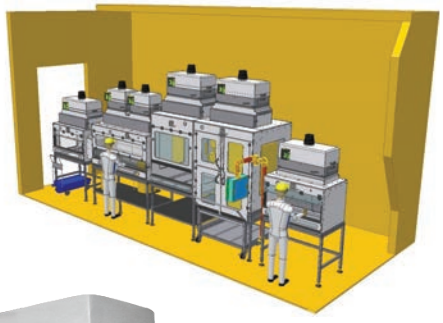
DUAL HEPA FILTRATION

100% of the HEPA filters provided by Flow Sciences are INDIVIDUALLY tested and manufactured under clean room conditions Our 4" pleated media pack was specifically engineered for Flow Sciences volumetric flow rate specifications with strict regards to sub-micron level containment requirements.

The increased surface area of the filter (approx. 238 sq. ft.) coupled with reduced pressure drop in a low flow environment, increases overall particulate capture rates, garnering higher efficiencies of laminar air diffusion. The HEPA filters are contained inside an engineered filter housing and work with low face velocity. Both of these guidelines satisfy NIOSH safety guidelines.

NIOSH has confirmed that HEPA filters work with 99.997% efficiency on nanomaterials down to the 3-20nm range. Flow Sciences' enclosures have been third-party tested and proven to contain down to less than 300 nanograms per cubic meter.

Animated 3-dimensional rendering with workers shown to scale



CUSTOMIZABLE SOLUTIONS

- Integrated powder to chemical nano-process
- Custom, multi-phase energy technology production design
- Bag-In/Bag-Out 99.99% HEPA filtration

NANOSAFE INC.
1800 Kraft Dr., Suite 107 • Blacksburg, VA 24060
info@nanosafeinc.com • 1.877.SAF.NANO / 540.443.9287
Fax: 877.836.1132 • www.NanoSafeInc.com

Registered
October 31, 2013

TEST DEVICE
FS11300 (Model # ETA 363024 ABA) - 3' Process Workstation with Bag-In/Bag-Out HEPA filtration, Manufactured by Flow Sciences, Inc. (Leland, NC)

OVERVIEW
NanoSafe evaluated the containment of aerosolized nanoparticled by a Flow Sciences, Inc. Process Workstation with Bag-In/Bag-Out, Dual HEPA Filtration (Fig. 1). Testing was adapted from ASHRAE 110-1995, and involved traverse-testing of the workstations ash and HEPA exhaust during werosolation of SiO_2 nanoparticles with a geometric mean diameter of 26 nm (Fig. 2). The test provides a useful measure of an enclosure's ability to contain aerosolized nanomaterials.

RESULTS
Internal concentrations of aerosolized SiO_2 nanoparticles ranged from 10,000 to 30,000 particles/cm^3 (Fig.3). Comparing measurements inside the enclosure and around the enclosure sash opening, containment of aerosolized SiO_2 nanoparticles was greater than 99.99% (Table 1). Sampling at the HEPA exhaust flow showed essentially zero particles and withing the sensitivity of the test, the results indicate no leakage of particles past or through the HEPA filter. Containment of aerosolized SiO_2 nanoparticles by the HEPA exhaust unit was greater than 99.999%.

FIG. 1. Flow Sciences, Inc. Process Workstation with Bag-In/Bag-Out HEPA Filtration.

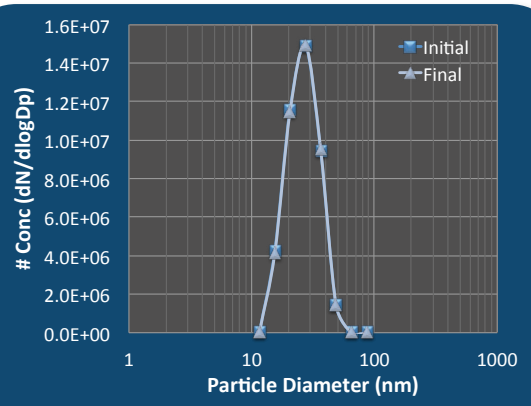


Fig. 2. Challenge aerosol size distribution

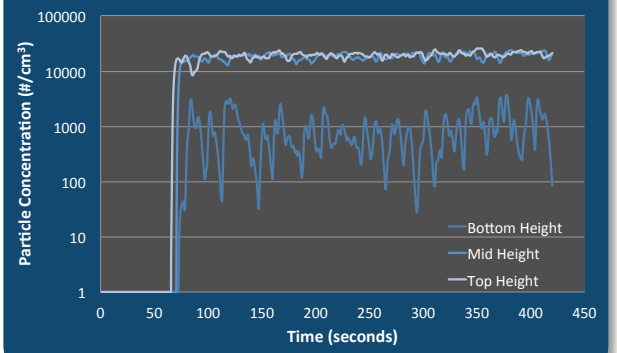


Fig. 3. Interior particle concentrations.

Table 1. Summary of enclosure performance.

Description	Nanoparticle Challenge (particles/cm^3)
Challenge concentration at 4 LPM	1.0 x 10^7
Mid to top-height in-enclosure particle concentration	10,000 – 30,000
Max. concentration observed during all exterior traverses	1.20
Avg. maximum from aerosol challenge exterior traverse tests	0.64
Max. concentration observed between dual-HEPA filters	0.08
Max. concentration observed at final HEPA exhaust	0.00
Estimate of particle containment (**Sash Opening**) – Avg. Max concentration from exterior traverse tests (0.64) / challenge concentration (10,000)	**> 99.99%**
Estimate of particle containment (**HEPA Exhaust**) – Avg. Max. concentration from exterior traverse tests (0.00) / challenge concentration (10,000)	**> 99.999%**

FLOW SCIENCES IS NOW NANOSAFE TESTED

Nanotechnology is at the forefront of industry developments and scientific advancements in medicine, energy, aeronautics and the environmental field. As with other applications that utilize toxic and sensitive substances, the safe handling of micro- and nano-gram materials depends on an understanding of the risks that laboratories and operators face when working on a scale smaller than 100 parts per 1000 m^3.

While the incredibly small scale of nanoprocessing has pushed our understanding of the physics, chemistry, and behavior of these materials, the one constant is that our biggest concern is occupational health and safety.

At the Flow Sciences headquarters, we have a testing laboratory where we confirm the performance of our products against ASHRAE 110 tracer gas standards and perform surrogate powder testing using lactose and naproxen sodium. Our engineers have researched the chemical and physical properties of nanomaterials and their varying levels of toxicity. From those research tests, we have expanded our line of fume hoods to include a series of low-flow containment hoods specifically developed for nanotech applications.

Third-party testing conducted by NanoSafe, Inc.—a leader in managing emerging nanotechnology EHS risks since 2007—has confirmed that our enclosure design effectively contains greater than 99.9% of aerosolized nanoparticles, oftentimes exceeding the in-house safety benchmarks set by our industry partners and customers. Along with our strict engineering controls, these third- party tests by NanoSafe ensure that Flow Sciences enclosures are the safest possible products on the market for use with hazardous and toxic nanomaterials.

Our testing laboratory is only one of the reasons why Flow Sciences is uniquely positioned to offer safety solutions for laboratories at the forefront of nanomaterial application development. Since 1987, we have been leaders in the engineering, designing, and testing of containment enclosures.

- Our patented exhaust systems and vented enclosures reduce vibration and stabilize airflow, increasing the accuracy and safety of your work, both of which are crucial in nanotechnology applications.

- Our nanotech containment enclosures are engineered with a removable plenum and high-speed impeller fan to maintain an ideal air pressure and air speed at the most crucial place in your laboratory: your workspace.

- For added stability, Flow Sciences enclosures also feature extruded anodized aluminum airfoils to smoothly direct airflow across your workspace. As air moves across the enclosure opening, it creates a curtain that forces loose particles to remain contained within the hood and out of the laboratory, away from personnel.

Whether you currently work with nanomaterials or your company is at the outset of nanoprocessing, Flow Sciences is committed to providing your company with solutions that maximize safety without compromising performance.

Flow Sciences custom engineered low-flow containment hoods create a more stable environment than traditional fume hoods, which are less effective when studying powder-based nanomaterial samples.

"...fume hoods were used more as a barrier of protection against harmful vapors rather than nanomaterials. Fume hoods were less likely to be used when the nanomaterial was in a dry powder form. As noted, this may have been due to the potential loss of dry powder form material and the risk of inhalation stemming from air turbulence generated by the fume hood exhaust system."

- ICONN Nanotech Survey, A Review of Current Practices in the Nanotechnology Industry, November 13, 2006

FLAME-TEC POLYPRO

- Application - Lithium
- Manifold for Argon and Air
- Fire suppression system and LED lighting
- Integrated cabinetry
- Tempered glass panels with gas shocks

NANO BULK POWDER

- Removable sliding sash
- Bag-In/Bag-Out dual HEPA filtration
- Drop sink for flat pan scale
- Bulk powder cut out
- LED lighting
- Automatic lift table

Product # shown:
CQ3613
72" w x 32" d x 40" h

This enclosure was used for the development of a new type of antibody drug conjugate (ADC) for treatment of people with HER2-positive metastatic breast cancer. The development of a cancer medicine that can attach to certain types of cancer cells and deliver potent cytotoxins directly to them, requires Flow Sciences to engineer enclosures that provide the product and personnel protection necessary for research and development where nano particulates are present.

- 10" glove ports
- HEPA filtration IN, Dual HEPA filtration OUT
- Internal pass thru with flange connection
- Face velocity alarm and stack light
- Pressure differential gauge
- Recessed cavity for scissor lift
- Electric receptacle mounted on rear wall
- Acrylic viewing panel

Application: ***LyoStarII***
Shown: CQ 3959

Product # shown:
CQ3517
48" w x 30" d x 30" h

CARBON NANOTUBES

- Bag-In/Bag-Out Dual HEPA 99.99% filters
- Stainless steel construction
- Chemically resistant white phenolic base
- Waste chute
- Tempered glass #3

VISIT

FLOWSCIENCES.COM

FOR MORE INFORMATION

1.800.849.3429