

## How air showers increase productivity and reduce operating costs of cleanroom operations

By Kevin Weist, president  
Clean Air Products

**Air showers quickly and effectively remove particulate that would otherwise be carried into the cleanroom; high air-flow volume combined with high nozzle velocity provide the power and force necessary for optimal operation.**

Whether the goal is high semiconductor yields or a flawless paint finish, controlled environments are integral to manufacturing processes. Air showers are vital to maintaining the clean environment; they help protect operations from the constant threat of air particulate contamination. Semiconductor, medical device, bio-tech, microelectronic, optics, pharmaceutical, aerospace, nanotechnology, and automotive industries require contaminant-free environments and use air showers as part of their operations.

Air showers are self-contained air recirculation systems installed at entrances to cleanrooms and other controlled

environments. Because people and products are the main sources of cleanroom contamination, these cleanroom entry systems quickly and efficiently remove particulate contaminants from workers or products before they enter a clean space.

Air showers blow high-velocity jets of HEPA-filtered air to remove loose particles from people and products before they enter a cleanroom. This decontamination process means cleaner air enters the cleanroom, reducing product defects and increasing production yields.

Additional advantages include longer-lasting cleanroom HEPA (high efficiency particulate air) filters because contaminant loads are lower. Without the pre-cleaning air showers provide, the main cleanroom air filtration system would absorb the entire contamination load, which increases energy consumption and maintenance costs.

### Alternative use

Decontamination air showers are usually used for cleaning gowned personnel before entering a clean environment. But they also are used to remove particulates as workers leave hazardous work areas before going out into the general public. Further, an exit decontamination air shower can prevent cross-contamination when moving from one work space to another.

### HOW AN AIR SHOWER WORKS

Air showers operate similarly to automated car wash pressure washer systems.<sup>1</sup>

In an air shower, a worker passes through the entry door and a sensor activates interlock magnets, which lock the air shower and cleanroom doors. Numerous adjustable nozzles



Air showers remove particulate that would otherwise be carried into the cleanroom.

blow high-velocity streams of Class 100 filtered air onto workers. The high-velocity air creates a flapping effect on clothing which produces a scrubbing action, removing particulates from cleanroom garments. To ensure all particulates are removed, workers raise their arms and rotate in place.



An air shower decontaminates those who enter a cleanroom.

Indicator lights signal the end of the cleaning cycle, and the cleanroom door opens. It takes four to eight seconds of cleaning time and another two to four seconds for the air shower to purge contaminated air prior to the worker exiting. Microprocessors control the cleaning and wait times.

**Preparation procedures**

Because people are the main source of cleanroom contamination, workers follow a series of procedures before entering a cleanroom. Air showers are the final cleaning step before entering a cleanroom. Prior to entering the air shower, workers put on appropriate cleanroom clothing in a gowning room—either a suit (which covers nearly the entire body) or a gown and cap or hood (which covers street clothes.<sup>2</sup>)

This “gowning” process disturbs and releases contaminants from street clothes that can settle onto cleanroom garments. Air showers remove the contaminants. This procedure helps to maintain cleanroom standards and also helps to lower operating costs. The decontamination procedure in the air shower means cleaner air enters the cleanroom, reducing product defects and increasing production yields. Cleanroom HEPA filters last longer because contaminant loads are lower. The cleanroom will require less maintenance and consume less energy. Also, a gown room air shower lowers costs by allowing garments to be used multiple times before thorough cleaning is needed.

**AIR SHOWER SPECIFICATION**

Important factors to consider when specifying an air shower include effectiveness (power and capacity) and air filtration.

**Effectiveness – power and capacity**

Power and capacity are the major influences on the effectiveness of an air shower. Cleaning power is determined by nozzle velocity: the speed at which air is pushed through the nozzles. It takes high-velocity air to dislodge contaminants; the higher the velocity or cleaning force, the more contaminants are removed.



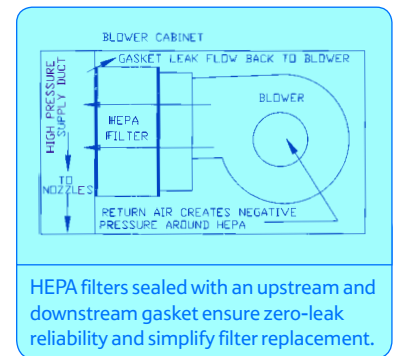
Capacity is the volume of air circulated in the system. More air volume means faster cleaning and removal of contamination through the filtration and recirculation system.

To specify the most effective air shower, look for one that produces nozzle velocities of 7,800 feet per minute (fpm) and circulates 1,900 cubic feet per minute (cfm) of air.

Velocity is measured at the nozzle, and cleaning effectiveness deteriorates as distance from the nozzle increases. Therefore, air showers should have a high number of air nozzles positioned as close to the worker or product as possible.<sup>3</sup> Ideally these nozzles should be positionable as well as removable to allow for easy inspection of the high-pressure supply ducts.

**Air filtration**

An air shower’s recirculating air filtration systems typically use two sets of filters. The first is a pre-filter for catching the bulk of contaminants. The second is a high-capacity, 99.97%-efficient HEPA filter.



HEPA filters sealed with an upstream and downstream gasket ensure zero-leak reliability and simplify filter replacement.

System blower units are usually mounted in the ceiling. If your facility has height restrictions, make sure the blowers can be mounted on the external wall.

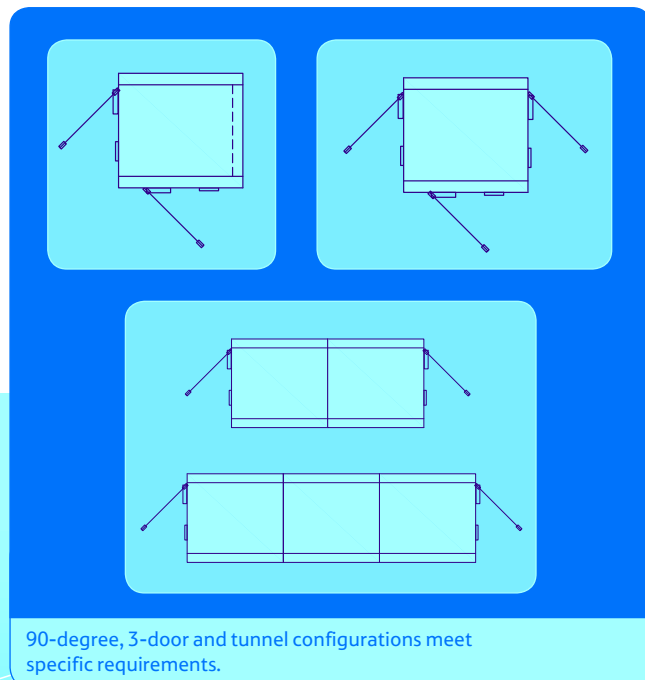
For easy routine maintenance, pre-filters should be changed regularly. Replacement filters are economical and easy to change.

## DESIGN CONSIDERATIONS

Modular air shower designs and configurations accommodate specific requirements for industry, as well as the number of personnel using the cleanroom. Modular cleanroom entry systems also simplify shipping and assembly.

A *straight-through* air shower with nozzles on two opposing walls cleans workers with ease. In a *90-degree* design, users enter on one side and exit to the right or left at a 90-degree angle. This configuration has fewer air nozzles than the straight-through design and requires the worker to turn 360 degrees to ensure sufficient cleaning. Other designs may have double doors or even three doors for entry and exit. Configurations include cart/parts-cleaning air showers, which are used for carts, conveyors, pallets and continuous-part operation. Low-profile air showers accommodate facilities with ceilings less than 96 inches. ADA air showers are sized so a wheelchair can turn around in the air shower.

The number of people that need to enter your cleanroom in a given amount of time will have a major impact on the size of the air shower. Designs range from single batch systems where one person uses the shower at a time, to tunnel systems for larger groups to pass through quickly. Tunnels are becoming more common because of the amount of cycle time needed for a shift change.



90-degree, 3-door and tunnel configurations meet specific requirements.

## DOORS

Access to the cleanroom must be controlled. Select a design with the appropriate air shower and cleanroom door interlocks.

Like air locks, air showers have entrance and exit doors that cannot be opened at the same time. Workers enter one side and exit on the opposite side. When one door opens, the other door's magnet energizes, preventing it from opening. During the cleaning cycle, both doors are energized (locked) to prevent anyone entering or leaving before the cycle is completed.<sup>4</sup>

## MATERIALS

High-quality air shower shells are constructed of steel and painted with a strong, durable cleanroom-compatible finish. For some medical, pharmaceutical, or extremely wet environments, stainless steel construction is ideal.

Some manufacturers offer economy units made of laminated particleboard. This option has major weaknesses, though. Temperature and humidity fluctuations can cause delamination. The materials are easy to damage and susceptible to joint loosening. Any of these conditions may generate particulate or biological contamination.



Stainless steel is the material of choice in many environments.

## AIR SHOWER CHECKLIST:

Effective air shower components and specifications include:

- Modular for easy configuration, shipment and assembly
- Stainless or painted-steel construction for durability and long life
- High velocity, high-volume air for cost-effective cleaning
- Recirculating filtration system including pre-filters and high-capacity HEPA filters for low cost and maintenance
- Several adjustable and easily placed nozzles for effective cleaning
- Magnetic door interlock system with appropriate controls for cleanroom control

Air showers are an important factor in ensuring good cleanroom performance. Air showers carefully selected to meet specifications, as well as proper worker training, documented procedures and a well-maintained system will increase production yields and reduce product defects and costs.

## CLEAN AIR PRODUCTS AIR SHOWERS

Clean Air Products offers a full range of air showers, including straight-through, 90-degree, low profile (blower on the side), 3-door, part/cart, tunnel and ADA-compliant configurations.

Clean Air Products air showers deliver high velocity air and a large air volume rate for fast, efficient cleaning. CAP701 Series air showers are constructed from an all-metal, painted steel shell, with no wood, plastic laminate or silicone. Stainless steel construction is also an option. Service to the mechanical equipment, blower, motor, HEPA filter and pre-filter is easily accomplished from the inside of the air shower.

Clean Air Products has been designing and manufacturing high quality cleanroom systems, components, equipment and supplies for a broad range of applications since 1969. Clean Air Products serves the cleanroom needs of the semiconductor, biomedical, pharmaceutical and aerospace/military industries, among others.

## NOTES

1. The car enters the wash chamber, doors at both ends close; high-pressure streams of water from all angles blast particles of dirt from the car. The cleaning cycle ends, a light comes on and the exit door opens.
2. Special cleanroom garments are made from smooth-surface synthetic materials such as Tyvek® and GORE-TEX®. They are designed to minimize the mechanical bond of particulates and easily shed them. Natural fiber materials such as cotton or wool tend to have rough surfaces which produce a high mechanical bond with particles.
3. The space between nozzles on opposite air shower walls is usually about 36 inches. Standing between nozzles an average-sized worker will be about eight inches away from any one nozzle. At that distance, air velocity is in the 6,500 to 7,000 fpm range, which is still an effective cleaning force.
4. Emergency power off (EPO) buttons should be included on internal and external walls.



Clean Air Products offers a full range of air shower configurations.



Parts-cleaning air showers can be part of a complete cleanroom system.

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