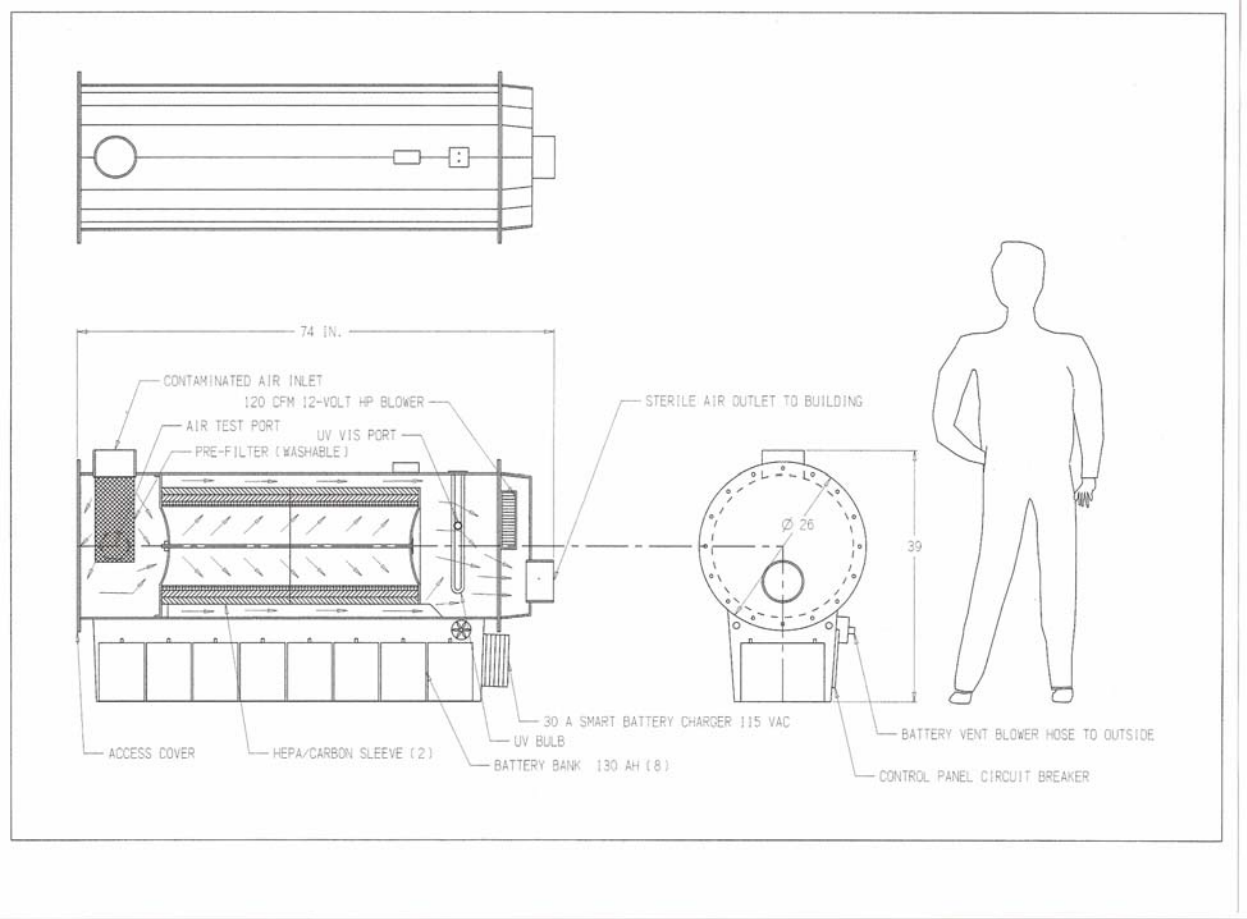
MCAS-120 WHOLE HOUSE AIR FILTRATION SYSTEM

(MULTI-CHAMBER AIR STERILIZATION)
FOR NBC WARFARE AGENTS
US PATENT 6,296,693 B1, OTHERS PENDING



PRODUCT SUMMARY

THE MCAS IS A UNIQUE MULTI CHAMBER NBC AIR FILTRATION UNIT DESIGNED TO REMOVE OR KILL ALL NUCLEAR-BIOLOGICAL-CHEMICAL AGENTS KNOWN. PRE-FILTERING AND GAS AGENT TESTING OCCURS IN CHAMBER ONE, CHAMBER TWO IS FOR MECHANCIAL AND CHEMICAL AGENT FILTRATION. CHAMBER THREE IS WHERE AIR IS EXPOSED TO ULTRAVIOLET RADIATION DOSES KILLING GASEOUS VIRUSES, MOLDS, AND BACTERIA, AND CHAMBER FOUR IS THE BLOWER CHAMBER DRAWING THE AIR THROUGH THE WHOLE FILTRATION SYSTEM AND BLOWING STERILE AIR INTO THE PROTECTED BUILDING.

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STAGE 1 PRE-FILTER

The outside contaminated air enters the MCAS at the pre-filter chamber consisting of a stainless steel micronic mesh to remove large particles in the air that are 125 microns and larger. The smallest particle that the human eye is able to see is 40 microns in diameter. This pre-filter is removable and washable and greatly extends the life of the next filtration stage. The gas agent test port allows allows a visual inspection of the pre-filter to see if it is dirty and restricting the air flow. This port also allows a common spray bottle to introduce a spray mist of hypochlorite and water to make the pre-filter moist so contaminated dust does not fly around during removal for cleaning.

STAGE 2 AIR CONTAMINANT TEST PORT

The pre-filter chamber also contains the GATP (Gas Agent Test Port) where the incoming air can be tested for chemical agents using the standard ARMY M256A test kit (included). A 4 inch NPTM (national pipe thread male) plug is unscrewed and the test card lays in this port and the plug is screwed in. Since the whole filter system is under negative pressure there is no risk of contamination but rubber gloves are used.

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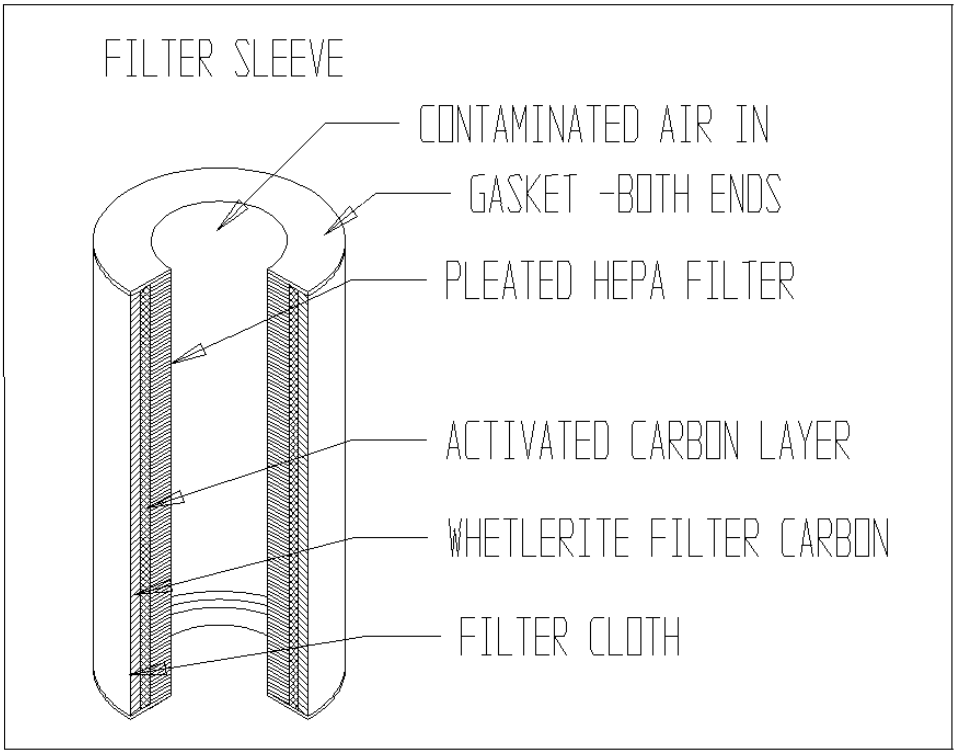
STAGE 3 HEPA



HEPA FILTER

Radioactive particles, some smoke, and biological agents can be removed by using a HEPA filter. This filter works by a physical straining; removing dust that is so fine that it is not visible to the human eye. The filter has 99.99% efficiency in removing particles which are 0.3 microns in diameter (.000012 inches) and larger. A micron is equal to .00004 inches or 4/100,000 of an inch. Although biological viruses range from .02 to .25 microns, they are dispersed or carried by larger aerosol or dust particles which can usually be removed by physical straining. The filter sleeve is

designed to be compressed from each end sealing against the gaskets. The compression is developed by a stainless steel acme rod (acme threads can not be cross threaded) running through the center of the filter sleeve. A plate nut on the one end of the acme rod drives the end plate up against the opposite end plate of the filter sleeve. This forms a complete and tight seal.

Contaminant	Particle Size -microns
Pollen	10-100
Human Hair	50-100
Plant Spores	10-50
Fly Ash	1-100
Fungal Spores	2-8
Insecticide Dusts	3-10
Anthrax Spore	1 x 4
Bacteria	0.1 - 50
Lung Damaging Dust	0.5 - 5
Tobacco Smoke	0.01 - 1
Burning wood smoke	0.2 - 3
Carbon Black	0.01 - 2
Fumes	0.001 -1
Viruses	.02 - .25

STAGE 4 CARBON FILTER

A mechanical filter, such as a HEPA filter, is not able to remove radioactive iodine gas. For this contaminant, an activated and impregnated carbon filter must be employed. The carbon filter purifies the air by processes called physical adsorption and chemical adsorption.

Physical adsorption is a process where activated carbon is used to perform a physical straining of contaminants, based on the molecular force, much like a coffee filtering process but using a much finer filter. Carbon is used because it has an extremely fine pore structure, much smaller than a HEPA filter, and contains tremendous surface area. For some types of carbon, a volume of l quart contains a surface area of 9 million square feet. This makes adsorption efficient and practical.

Chemical adsorption is a process where impregnated carbon is used in the filter. Impregnated carbon has been treated with specific chemicals which have an affinity to attract and thereby remove specific toxins or gases. There is a specific carbon to

remove radioactive iodine gas and the efficiency of removing the contaminant is based on the amount of time the contaminant is in contact with the carbon. This required period of time necessary to remove the contaminant is known as the *residence time.* Radioactive iodine gas requires a residence time of 0.35 seconds.

The filter sleeve has two layers of carbons. The first layer consists of *activated carbon* which removes radioactive iodine gas generated from a nuclear explosion or nuclear power plant accident. This filter makes it unnecessary to take Potassium Iodine to block the absorption of radioactive iodine into the human thyroid. Iodine tablets only work if they are taken 24 hours in advance of breathing the radioactive iodine gas. The second layer of carbon is called Whetlerite/TEDA Carbon and is specifically designed to remove chemical warfare agents. The required resonance time is 0.35 seconds. Both carbons are designed for a minimum of 0.4 seconds.

Burning forests produce toxic gases such as: nitrogen oxides, benzene gas, toluene gas, and carbon dioxide. Toxic gases produced from burning plastics and industrial chemicals are known as pyrotoxins. These pyrotoxins are: nitric acid gas, chlorine gas, chlorinated dioxin gas, hydrochloric acid gas, acrolein gas, and sulfuric acid gas. These gases would be dangerous primarily in the immediate blast area for a number of days. These toxins can be removed from the fresh air supply using a carbon filter designed to remove acid gas. This stage requires an impregnated carbon filter specifically designed to remove these acid gases. Complete filtering requires a residence time of 0.35 seconds.[1] The activated carbon in the filter sleeve will filter out these acid gases.

A chemical warfare filter functions like impregnated carbon in the radioactive iodine gas filter. The particular carbon that must be used is called "Whetlerite Carbon", meeting military specifications Mil-C-0013724C (EA) Grades 1 to 4, and is used in military blast shelters. This carbon has been impregnated with copper, chromium, and silver to specifically remove: carbon sulfate gas, cyanide gas, phosgene oxime gas, mustard gas, phosgene gas, cyanogen chloride, sarin gas, soman gas, VR-55 gas, VX gas, and other chemical warfare agents. It is extremely efficient, lasts many years, and is very expensive. Complete filtration requires a residence time of 0.35 seconds.

STAGE 5 POST CARBON FILTER

The outside layer of the carbon filter sleeve contains a "post filter". When air is drawn through a carbon filter, some very fine particles of carbon are removed and deposited outside of the filter. Because they are extremely fine, they get into everything just by air movement within the shelter or house; thus, they are easily inhaled. These particles are called "carbon fines" and are contaminated and must be kept within the filter. This is accomplished by using a micronic fabric on the outside layer of the filter sleeve to contain the carbon fines within the filter.

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STAGE 6 ULTRAVIOLET RADIATION

Viruses vs. Bacteria

Viruses are tiny geometric structures that can only reproduce inside a living cell. They range in size from 0.02 to 0.25 microns. When they are outside a living cell they are dormant but when it enters a host cell, it begins to generate more virus particles. Bacteria are one cell living organisms with an average size of 1 micron that does not need a living host. Many bacteria are beneficial to humans and necessary for the breakdown of organic wastes.

Killing Organisms

Many viruses and bacteria are so small that they are not able to be filtered physically by a HEPA or effectively adsorbed by the Carbon filter. Virtually all biological warfare agents can be removed by filtering out what they are carried on such as a dust particle or aerosol droplet. Viruses however, are usually in the gaseous state and need to be killed by ultraviolet radiation (UVC) or ultraviolet germicidal irradiation (UVGI) which is an ultraviolet light on the C scale, specifically at a wavelength of 254 nm which does not generate ozone. The amount of energy required to completely kill an organism such as a virus, bacteria, mold, etc is called the Kill Energy which varies with each organism. The ultraviolet light next to the filter sleeve stem develops extremely high kill energy on the air flowing past this chamber to assure that the kill rate is absolute. Exposure time is based on light intensity multiplied by time. The exposure imposed on any organism in the MCAS-120 UV chamber is 17,227 uw/sec/$cm^{2.}$ (microwatts/sec/square centimeter) Kill rates for various organisms are listed below. Note that not all organisms are gaseous.

Ultraviolet Radiation Dangers

UV radiation does have two dangers. When exposed to bare skin it will produce a sunburn (radiation burn) and it is also damaging to the human eyes and can result in conjunctivitis (inflammation of the mucous membranes). When changing the bulbs, the UV light must be turned off to avoid these dangers. On the side of the MCAS housing is a visual site glass to visually verify if the ultraviolet light is on. This glass sight port is thick enough to prevent

any appreciable radiation negatively affecting nearby occupants.

AMOUNT OF GERMICIDAL SHORTWAVE (254nm) ULTRAVIOLET RADIATION NECESSARY FOR COMPLETE DESTRUCTION OF VARIOUS ORGANISMS

Bacteria	**UV Dose** uw/sec/cm^2	**Bacteria**	**UV Dose** uw/sec/cm^2
Agrobacterium lumefaciens 5	8,500	*Pseudomonas aeruginosa* (Environ.Strain) 1,2,3,4,5,9	10,500
Bacillus anthracis 1,4,5,7,9 (anthrax veg.)	8,700	*Pseudomonas aeruginosa* (Lab. Strain) 5,7	3,900
Bacillus anthracis Spores (anthrax spores)*	46,200	*Pseudomonas fluorescens* 4,9	6,600
Bacillus megatherium Sp. (veg) 4,5,9	2,500	*Rhodospirillum rubrum* 5	6,200
Bacillus megatherium Sp. (spores) 4,9	5,200	*Salmonella enteritidis* 3,4,5,9	7,600
Bacillus paratyphosus 4,9	6,100	*Salmonella paratyphi* (Enteric Fever) 5,7	6,100
Bacillus subtilis 3,4,5,6,9	11,000	*Salmonella Species* 4,7,9	15,200
Bacillus subtilis Spores 2,3,4,6,9	22,000	*Salmonella typhimurium* 4,5,9	15,200
Clostridium tetani	23,100	*Salmonella typhi* (Typhoid Fever) 7	7,000
Clostridium botulinum	11,200	Salmonella	10,500
Corynebacterium diphtheriae 1,4,5,7,8,9	6,500	*Sarcina lutea* 1,4,5,6,9	26,400
Dysentery bacilli 3,4,7,9	4,200	*Serratia marcescens* 1,4,6,9	6,160
Eberthella typhosa 1,4,9	4,100	*Shigella dysenteriae* - Dysentery 1,5,7,9	4,200
Escherichia coli 1,2,3,4,9	6,600	*Shigella flexneri* - Dysentery 5,7	3,400
Legionella bozemanii 5	3,500	*Shigella paradysenteriae* 4,9	3,400
Legionella dumoffill 5	5,500	*Shigella sonnei* 5	7,000
Legionella gormanil 5	4,900	*Spirillum rubrum* 1,4,6,9	6,160
Legionella micdadei 5	3,100	*Staphylococcus albus* 1,6,9	5,720
Legionella longbeachae 5	2,900	*Staphylococcus aureus* 3,4,6,9	6,600
Legionella pneumophila (Legionnaire's Disease)	12,300	*Staphylococcus epidermidis* 5,7	5,1200
Leptospira canicola-Infectious Jaundice 1,9	6,000	*Streptococcus faecaila* 5,7,8	10,000
Leptospira interrogans 1,5,9	6,000	*Streptococcus hemolyticus* 1,3,4,5,6,9	5,500
Micrococcus candidus 4,9	12,300	*Streptococcus lactis* 1,3,4,5,6	8,1200
Micrococcus sphaeroides 1,4,6,9	15,400	*Streptococcus pyrogenes*	4,200
Mycobacterium tuberculosis 1,3,4,5,7,8,9	10,000	*Streptococcus salivarius*	4,200
Neisseria catarrhalis 1,4,5,9	8,500	*Streptococcus viridans* 3,4,5,9	3,1200
Phytomonas tumefaciens 1,4,9	8,500	*Vibrio comma* (Cholera) 3,7	6,500
Proteus vulgaris 1,4,5,9	6,600	*Vibrio cholerae* 1,5,8,9	6,500
Molds	**UV Dose**	**Molds**	**UV Dose**
Aspergillus amstelodami	77,000	*Oospora lactis* 1,3,4,6,9	11,000
Aspergillus flavus 1,4,5,6,9	99,000	*Penicillium chrysogenum*	56,000
Aspergillus glaucus 4,5,6,9	88,000	*Penicillium digitatum* 4,5,6,9	88,000
Aspergillus niger (breed mold) 2,3,4,5,6,9	330,000	*Penicillium expansum* 1,4,5,6,9	22,000
Mucor mucedo	77,000	*Penicillium roqueforti* 1,2,3,4,5,6	26,400
Mucor racemosus (A & B) 1,3,4,6,9	35,200	*Rhizopus nigricans* (cheese mold) 3,4,5,6,9	220,000
Protozoa	**UV Dose**	**Protozoa**	**UV Dose**
Chlorella vulgaris (algae) 1,2,3,4,5,9	22,000	*Giardia lamblia* (cysts) 3	100,000
Blue-green Algae	420,000	Nematode Eggs 6	40,000
E. hystolytica	84,000	Paramecium 1,2,3,4,5,6,9	200,000
Virus	**UV Dose**	**Virus**	**UV Dose**
Adeno Virus Type III 3	4,500	Influenza 1,2,3,4,5,7,9	6,600
Bacteriophage 1,3,4,5,6,9	6,600	Rotavirus 5	24,000
Coxsackie	6,300	Tobacco Mosaic 2,4,5,6,9	440,000
Infectious Hepatitis 1,5,7,9	8,000		
Yeasts	**UV Dose**	**Yeasts**	**UV Dose**

Baker's Yeast 1,3,4,5,6,7,9	8,1200	*Saccharomyces cerevisiae* 4,6,9	13,200
Brewer's Yeast 1,2,3,4,5,6,9	6,600	*Saccharomyces ellipsoideus* 4,5,6,9	13,200
Common Yeast Cake 1,4,5,6,9	13,200	*Saccharomyces sp.* 2,3,4,5,6,9	17,600

1. "The Use of Ultraviolet Light for Microbial Control", Ultrapure Water, April 1989.
2. William V. Collentro, "Treatment of Water with Ultraviolet Light - Part I", Ultrapure Water, July/August 1986.
3. James E. Cruver, Ph.D., "Spotlight on Ultraviolet Disinfection", Water Technology, June 1984.
4. Dr. Robert W. Legan, "Alternative Disinfection Methods-A Comparison of UV and Ozone", Industrial Water Engineering, Mar/Apr 1982.
5. Unknown
6. Rudolph Nagy, Research Report BL-R-6-1059-3023-1, Westinghouse Electric Corporation.
7. Myron Lupal, "UV Offers Reliable Disinfection", Water Conditioning & Purification, November 1993.
8. John Treij, "Ultraviolet Technology", Water Conditioning & Purification, December 1995.9. Bak Srikanth, "The Basic Benefits of Ultraviolet Technology", Water Conditioning & Purification, December 1995

STAGE 6 BLOWER

The centrifugal air blower is a high pressure reverse curve motorized impeller located at the end of the filter housing after the ultraviolet light to create negative pressure inside the filter housing. This blower pushes filtered air into the protected structure. If the air leaving the structure is restricted, the structure will be positively pressurized preventing contaminating agents from penetrating the house. See the MCAS 120 Operator's Manual for weatherizing the protected structure.

MCAS-120 INSTALLATION

The MCAS can be placed in a basement, or mechanical room or anywhere the distribution duct can reach other rooms. The MCAS-120 will protect to an 18,000 ft^3 structure that is properly weatherized for infiltration leaks.

Inlet air is taken from outside the house using the stainless steel intake manifold that is supplied with the MCAS 120. This requires drilling a 6 inch diameter hole through an outside wall.

Outlet air exits the structure through infiltration leaks in the house and the supplied stainless steel air outlet manifolds. Infiltration occurs through the perimeter of doors, windows, electrical boxes on outside walls and ceilings, and anywhere air can penetrate and navigate around a hole or fixture. The one inch diameter air outlet manifolds are installed high on the wall to vent heat and spent air. The valves on the outlet manifolds are adjusted to maintain at least 0.1 inch water gage static pressure inside the structure.

BATTERY BANK

The battery bank is composed of eight 130 amp hour deep cycle marine 12 volt lead acid batteries connected in parallel. Terminal fuses are used to protect the batteries. They are maintained in a fully charged state by a 30 amp Smart battery charger. Although very little hydrogen gas is generated because the charge per cell is 0.626 amps, which is well below the 2.5 amp/cell threshold, traces of hydrogen gas are vented to the outside of the building by a 12-volt blower and hose from the top of the battery bank to the outside of the building. A stainless steel battery gas vent manifold is supplied to be installed on the protected building exterior wall.

MCAS 120 Location and Hook-up

1. One 6 inch air inlet duct
2. One 6 inch air outlet or duct
3. One 1 inch battery vent hose
4. One 115 VAC power cable

The MCAS 120 should be located in a place where AC power is available and where the air intake manifold can be installed on a vertical wall and the sterile air can be supplied to a central location in the house. The maximum temperature for the unit is 120°F.

Uncrating the MCAS 120

1. Remove the wooden slats on the cover of the crate.
2. Remove 50 feet of 6 inch diameter duct hose
3. Remove the four filter sleeves 50 lbs each
4. Remove the filter chamber 150 lbs
5. Remove the wires connecting the batteries together.
6. Remove the eight batteries 70 lbs each.
7. Remove the fiberglass battery housing 40 lbs

Assembling the MCAS 120

1. Place the battery housing in place
2. Place all 8 batteries in the battery housing.
3. Connect all the positive wires and all the negative wires
4. Connect the quick connectors to the circuit breaker panel
5. Lay the filter chamber on the battery housing
6. Remove the blower housing cover using wrenches
7. Remove the plate nut
8. Slide two of the filter sleeves into place with the rod in the center of the housing.
9. Screw on the plate nut and hand tighten
10. Rebolt the blower housing cap using the stainless bolts.

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MCAS 120 SPECIFICATIONS

Air blower life .....60,000 hours
Air blower type .....8-in dia. Rev curve centrifugal 12-V, 21 watt
Air blower volume .....120 cfm @ 0.5 in S.P. W.G.
Air filter.....HEPA 99.99% @ .3 u
Air filter-carbon-activated residence time .....0.4 sec
Air filter-carbon-Whetlerite residence time.....0.4 sec
Air filter post carbon 3u
Air inlet manifold .....Stainless for vertical wall
Air outlet manifold .....stainless (6) for vertical wall
Assembly time.....30 min to install filter sleeves
Batteries.....8-130 amp hour deep cycle LA marine 12V
Battery housing .....structural fiberglass
Battery vent manifold .....stainless for vertical wall
Capacity.....18,000 ft3 with sealed building
Circuit Protection.....magnetic circuit breakers and terminal fuses
Duct .....6 inch diameter 50 ft supplied
Duration-blower 24hr/day .....16 days
Duration-blower and light 24 hr/day.....7 days
Electrical meter .....voltage and amp/hr digital
Electrical power.....2 amps AC for battery charger
Filter Chamber .....structural fiberglass
Flame spread .....25-50 Type II, ASTM E84
Shipping weight.....800 lbs.
Shipping dimensions.....30 x 78 x 46 in crated
Ultraviolet Light .....254nm 12 VDC
Ultraviolet Radiation dose .....17,227 mw/sec/cm^2

SEE MCAS 120 OPERATOR'S MANUAL FOR COMPLETE INSTALLATION AND OPERATION INSTRUCTIONS.

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