



## **S.E.A.M. SYSTEM 100**

### **NUCLEAR – BIOLOGICAL- CHEMICAL WARFARE AIR FILTRATION**

MADE IN UNITED STATES



### **NBC AIR FILTRATION FOR HUMAN BREATHING AIR**

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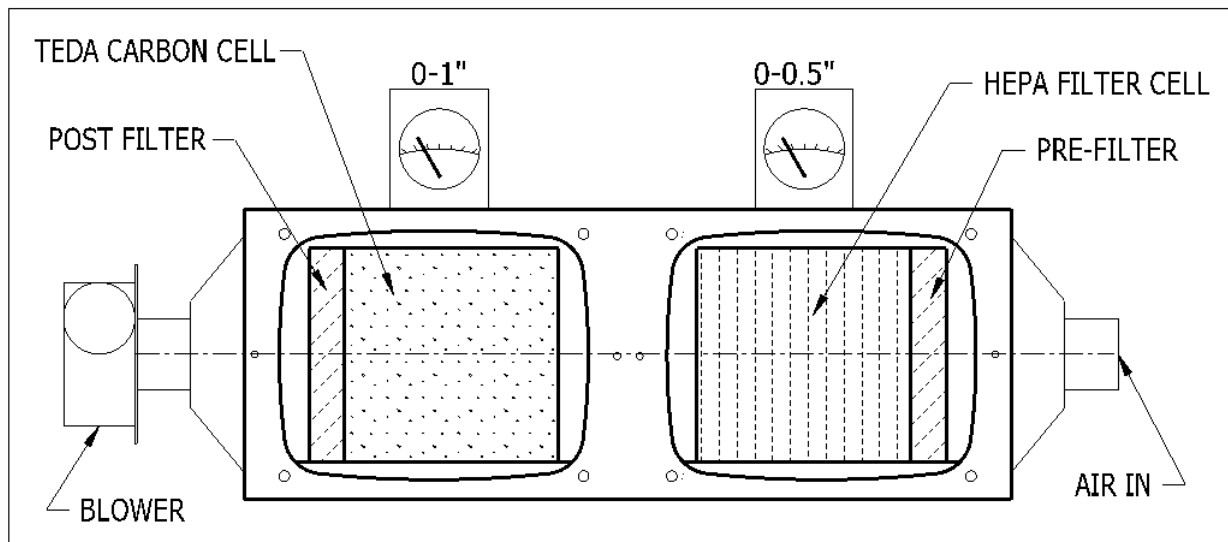


## BREATHING AIR

The Severe Environment Air Module 100 or SEAM 100 is a stainless-steel NBC air filter military product listed on the United States Munitions List (USML). It cannot be exported from the US without a license from the United States Department of Defense. Violations for export carry severe federal criminal penalties.

The SEAM System 100 (Bag in/Bag out or BIBO) is designed for human life support and produces 100 cfm @ 1 in. W.G. It operates 24 hours per day and is

the standard system used in nuclear, biological, and chemical warfare laboratories, and hardened military structures. In order to qualify as a long-term NBC air filtration system it must be adaptive for more than 30 days, all of the filter elements must be able to be safely removed and replaced. The trays and cells are replaced using a “bag in bag out” system so there is no human contact with the contaminated filter elements.



In the case where the shelter is located in the fallout area, any PRE/HEPA filter in any air filtration system located in the shelter will become too radioactive and dangerous to the shelterists to keep in the filter housing even though the vacuum gage may read normal. The level of radioactivity in the filter comes from radioactive contaminants trapped in the PRE-FILTER and/or HEPA Filter which can be measured by a radiation meter by just standing in front of the access doors and holding the radiation meter at the center of the access cover. When the reading is near 1 rad/hr.,

the PRE- filter should be changed. Almost all of the initial fallout will have fallen in the first 24 hours so changing the Pre/HEPA filters should automatically be implemented after this period. See the SEAM 100 OPERATOR MANUAL for replacing filter elements.

**The air filtration system consists of two chambers and four stages of air filtration:**

Contaminated air enters on the right of the unit through a 4-inch diameter inlet and passes through the first chamber containing two stages of air filtration:

**STAGE 1 Pre-Filter** is a disposable 2-inch deep prefilter MERV 16 which removes 95% of particles from 0.3 – 1.0 microns in size.

**STAGE 2 HEPA Filter**

H.E.P.A. or Highly Efficient Particulate Air filter removes radioactive particles, dust particles, pollen, and 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 99.999% efficiency in removing particles which are 0.3 microns in diameter (.00012 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 be removed by physical straining. The filter tray is designed to be compressed using the clamp rotator on the face of each chamber.

<b>Contaminant</b>	<b>Particle Size -microns</b>
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

The second chamber contains Stage 3 and Stage 4 filter elements.

### Stage 3 TEDA Carbon Cell

A mechanical filter, such as a HEPA filter, is not able to remove radioactive iodine gas generated from a nuclear explosion or nuclear power plant accident. For this contaminant, a 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 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 1 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 *residence time*. Radioactive iodine gas requires a residence time of 0.25 seconds. 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.

**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 0.25 seconds. The activated carbon filter tray will filter out these acid gases. This activated carbon tray is not necessary for the air cooling the generator.

The SEAM System 100 uses a carbon cell containing pure ASZM-TEDA carbon specifically designed to remove radioactive iodine gas, chemical warfare agents, and acid gases. The required resonance time or contact time with carbon is 0.25 seconds. This carbon meets military specifications Mil-C-0013724C (EA) Grades 1 to 4, and is used in military 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 chemical warfare agent filtration requires a residence time of 0.25 seconds. The carbon cell used has a residence time of 0.30 seconds and weighs approximately 35 lbs. and can be replaced using the Bag In/Bag Out system.

**STAGE 4 Post-Filter** is a disposable MERV 16 Post-Filter to remove carbon fines from the carbon cell. The photo below shows the post filter in place in chamber 2 with the HEPA cell and pre-filter partially pulled out.

**BIBO** -All filter elements are changed using a Bag-In/Bag-Out process to prevent human contact with warfare agents. Any one or all of the filter elements are be changed according to radiation levels or pressure drop across the filters indicated by the pressure gages above each chamber.

**Test Port**- chemical agents can be detected and identified using the visual test port which can hold a standard Army M-256A chemical agent test card (supplied)

**Blower**- the 24-volt centrifugal blower consumes 45 watts/hr. and is designed to operate 24 hrs./day for 30,000 hours. A spare blower is included.



**TEST VIEW PORT**



**HEPA AND PRE-FILTER**

**Filter Clamps**, shown by **red arrow** are used on all filter elements to press filters in place creating a positive seal. The filter clamps are moved using a common ratchet to rotate the studs on the face of each chamber.



TEST PORT WINDOW



CHANGE-OUT BAG



PRESSURE GAGES

## **MANIFOLDS**

Air manifolds on the existing shelter or house need to be adapted to accept a 4-inch ID hose. SEAM 100 units installed in a home or office require an optional stainless steel inlet air manifold that needs to be installed on the side of a house and not more than 25 feet away from the SEAM 100.

## **ENGINEERING STANDARDS COMPLIANCE**

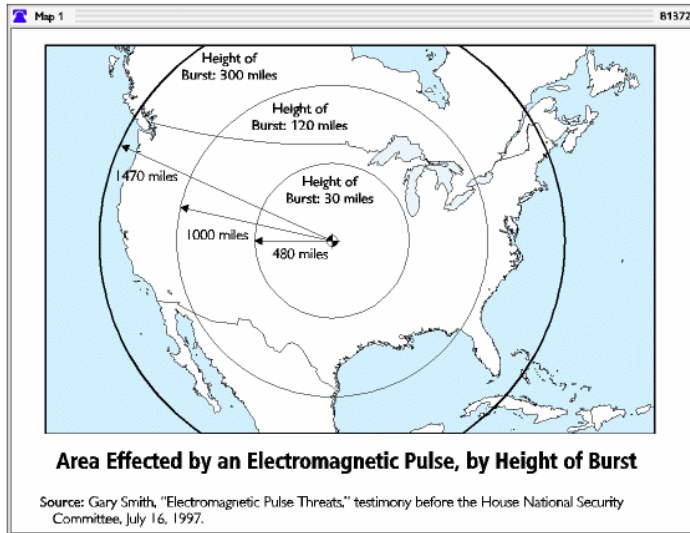
- ASME N509 2002, Nuclear Power Plant Air-Cleaning Units and Components (construction guidelines)
- ASME N510 1989 Testing of Nuclear Air Treatment System (Pressure Decay Testing Guidelines)
- ASME BPVC SECTION IX. Qualification Standard for Welding (Welding Certs)
- IES-RP-CC-008-84 Institute of Environmental Sciences Recommended Practice for Gas Phase Adsorber Cells (Leak testing for Carbon Cell)
- Quality Assurance: NQA-1

### **The 24-volt air blower provides the following advantages:**

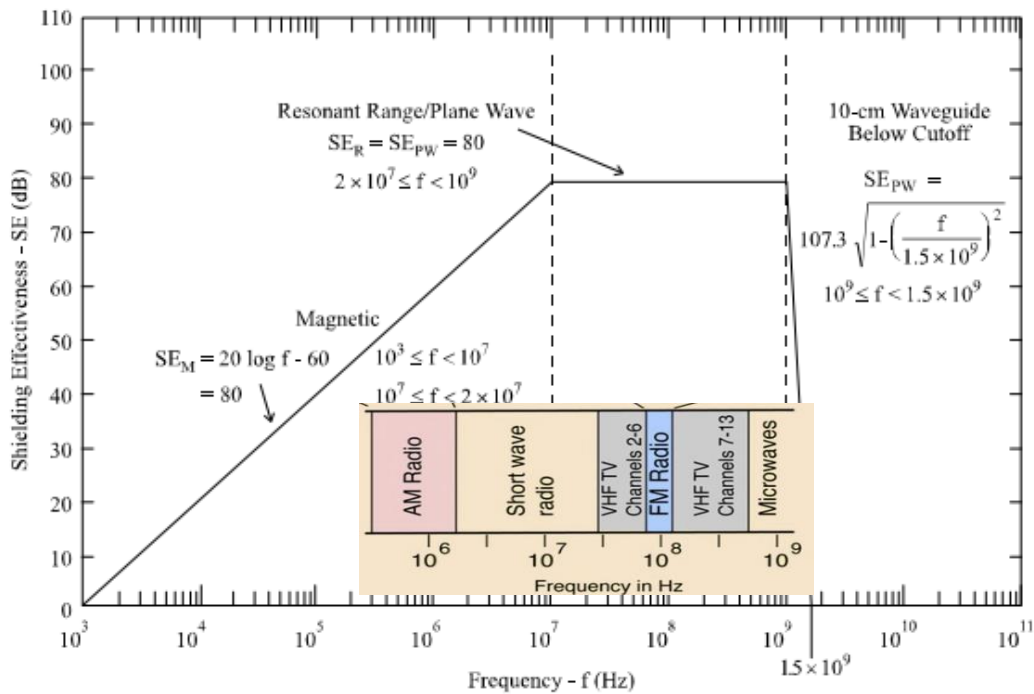
1. Constant fresh air which means that the temperature is stable inside the shelter with little or no fluctuations.
2. A consistent known volume of air enters the shelter. There is no chance of a person over-cranking a manual blower, exceeding the residence time of the TEDA carbon.
3. Normal and consistent levels of oxygen, carbon dioxide, and moisture are maintained in the shelter.
4. Shelterists can sleep without having to wake up and crank the air blower.
5. The shelter is always under positive pressure. This is especially advantageous for chemical warfare environments where all contaminants must be kept out of the shelter.
6. The blower has a very low and constant blower noise equivalent in decibels (dB) to a dishwasher.
7. A gas valve is not needed because the shelter is always under positive pressure. Ball valves should still be placed on air inlet and outlet pipes, unless overpressure choking is used.
8. Unlike manual air blowers, electric air blowers allow life support for young children, people who are sick, people or are injured or the elderly entering the shelter who would not be able to operate a manual hand crank air blower. Military applications do not allow hand-crank blowers for NBC air filtration equipment.

# EMP SHIELDING

**Figure 1. Estimated Area Affected by High-Altitude EMP<sup>1</sup>**



The SEAM 100 is self-contained and not connected to the electrical grid and is therefore only subject to EMP from overhead. The SEAM 100 was designed to meet MIL-STD-188-125: "High Altitude Electromagnetic Pulse (HEMP) Protection for Ground-Based C4 Facilities Performing Critical, Time-Urgent Missions Part 1: Fixed Facilities" 17 July 1998. This is the EMP standard in the world. Any product that is not designed to this standard is not EMP shielded.

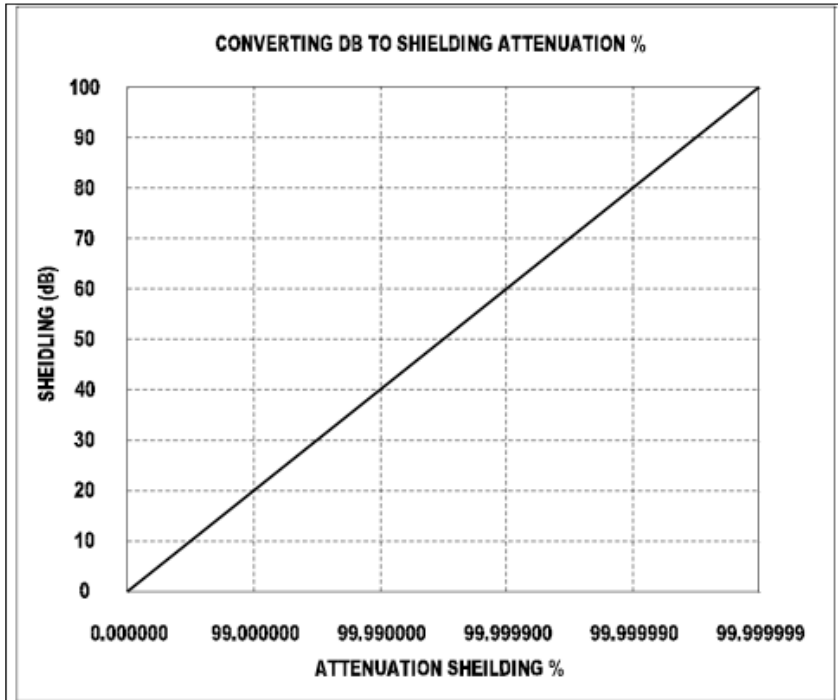


**FIGURE 4. Minimum HEMP shielding effectiveness requirements (measured in accordance with procedures of Appendix A).**

<sup>1</sup> PRINCIPLES OF PROTECTION, US Handbook of Weapon Fundamentals and Shelter Engineering Design Standards, 6<sup>th</sup> edition 2013.



All mission essential equipment (MEE) vulnerable to EMP are required to be mounted in an EMP Shielded Enclosure meeting shielding standards of MIL-STD-188-125. The MEE in the SEAM 100 is the MPPT Solar Charge Controller, battery charger, and the Solar Panels which are stored in an EMP shielded enclosure. The EMP shielded enclosures meet QQ-A-200/8, MIL-C-7438, MIL-T-10727, and shielding minimums of MIL-188-125. The SEAM 100 can also be supplied with a 6 KW dual fuel gas/propane generator with an EMP shielded enclosure in place of the solar powered system. EMP shielded enclosures must be shielded in compliance Figure 4 and the Attenuation graph below.

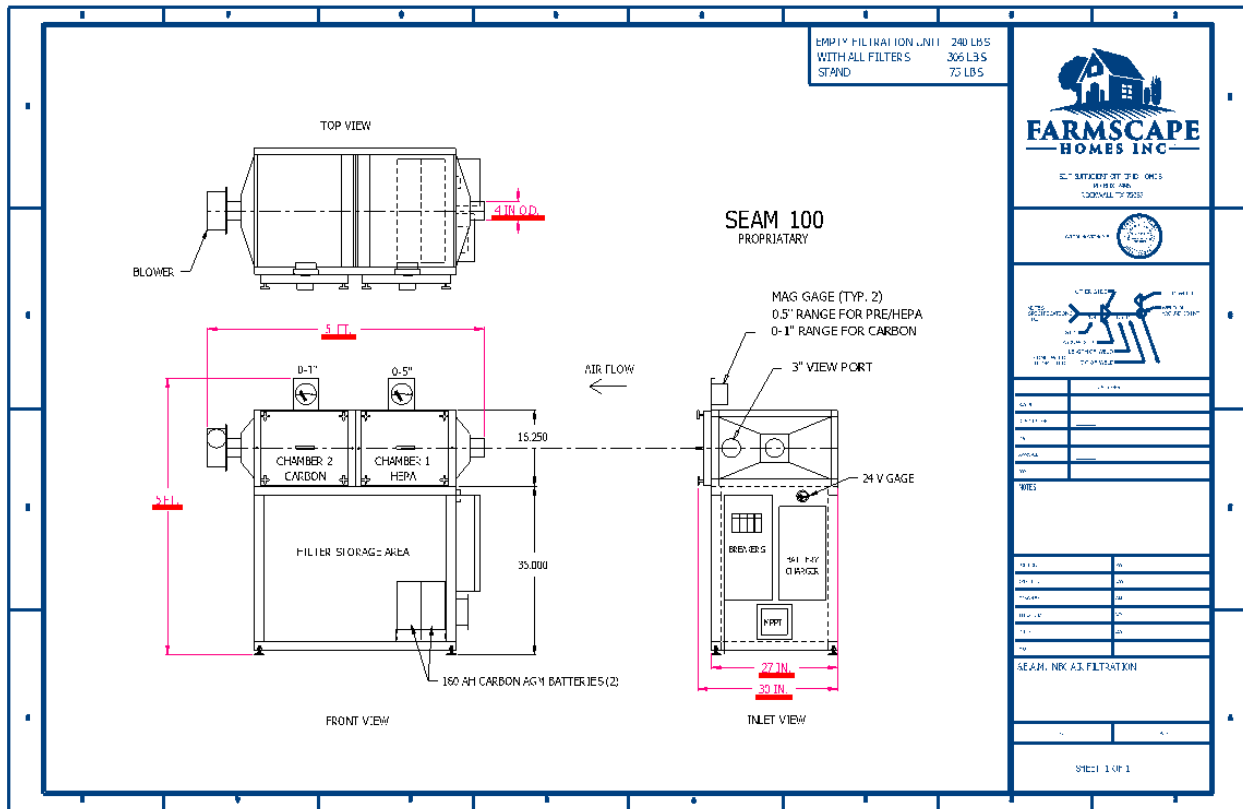


The term decibel or dB is a well-known term for measuring the level of sound. It is actually not a unit of measurement but is really a measurement of a ratio. Because of this ratio, it is also used in the field of EMP to compare levels of shielding. As shown, a level of 20 dB results in a 99 percent attenuation, and a level of 40 dB results in 99.99 percent shielding. Note that the shielding levels are not linear, thus the need for a logarithmic ratio. All gaskets and air vents for EMP have a dB

rating, which should be a minimum of 80 dB. The shelter hull and earth over the shelter are usually not considered to provide any EMP shielding. Note from Figure 4 that a decibel level of 80 is required to shield in the magnetic ( $SE_M$ ) and Resonant, ( $SE_R$ ) and the plane wave ( $SE_{PW}$ ). All of the EMP shielded enclosures supplied with the SEAM 100 have a shielding level of 80+ dB. This applies to the solar charge controller, solar panels, battery charger, and generator which represent the MEE. This MEE equipment is to be stored prior to an EMP event and taken out of the shielded enclosures after the EMP event and used in normal operation.

The golden rule for EMP protection in underground shelters or above ground structures is, “DO NOT USE THE SHELTER HULL OR ABOVE GROUND STRUCTURE AS AN EMP SHIELD AND DO NOT USE THE EMP SHIELD AS A SHELTER”. The major problem in making underground shelters EMP safe is dealing with all the POEs or “points of entry” in underground shelter hulls that allow EMP to enter the shelter. Anything penetrating the hull such as entranceways, emergency escape tunnels, air inlet hoses, air outlet hoses, water hoses, electrical lines, and radio cables, etc., all need EMP shielded gaskets and/or EMP shielded air vents. Steel

does not make a good Faraday Cage because it is not conductive enough. Electrical conductivity is measured in Siemens/meter<sup>2</sup> ( $\delta$  S/m<sup>2</sup>). The minimum conductivity for a Faraday Cage to completely shield an EMP to MIL-188-125 is 15,000,000 Siemens m<sup>2</sup>. Steel has a conductivity of only 7,000,000 S/m<sup>2</sup> so it is not conductive enough to effectively attenuate all EMP frequencies. Aluminum has a conductivity of 35,000,000 S/m<sup>2</sup> and copper 60,000,000 S/m<sup>2</sup> so both materials are very well suited for a Faraday Cage to effectively shield all EMP frequencies.



### TESTING INCOMING AIR FOR CHEMICAL AGENTS



The M256A1 Chemical Detection Kit is placed into the card holder inside chamber 1 and is designed to detect all chemical agents in gas or aerosol form. It will require some study of the procedures to properly use the kit.

## SEAM 100 SPECIFICATIONS

Air Inlet Hose.....	4 in I.D smooth bore
Air inlet type .....	4 in stainless hose barb
Blower power consumption .....	45 watts
Blower sound level .....	23 Db
Blower volume -24 volt @ clean filter .....	100 cfm
Carbon Cell Type and lbs. ....	TEDA 100% - 30 lbs.
Carbon Certifications .....	included
Compliances:	
--ASME BPVC SECTION IX. Qualification Standard for Welding (Welding Certs)	
--ASME N509 2002, Nuclear Power Plant Air-Cleaning Units and Components (construction guidelines)	
--ASME N510 1989 Testing of Nuclear Air Treatment System (Pressure Decay Testing Guidelines)	
--IES-RP-CC-008-84 Institute of Environmental Sciences Recommended Practice for Gas Phase	
--Adsorber Cells (Leak testing for Carbon Cell)	
--Principles Of Protection 1990, 2013 6 <sup>th</sup> edition, 2023 7 <sup>th</sup> edition`	
--Quality Assurance: NQA-1	
DC Electrical safety .....	circuit breaker panel mounted on filter housing frame
DC Meter-analog .....	0-32 V
DC Power with stands.....	3-200-watt panels - 90 mph
DC Power Storage .....	2- 180 AH 12-volt Pure Carbon AGM wired in series
DC Solar Charge Controller.....	50 A MPPT
Door Latch .....	screw clamp
Export Status US.....	export license required
Filter change method.....	BIBO
Filter Change Out Bag Control .....	3- glove
Filter change time .....	20 min.
Filter change-out bag securing method.....	synch strap
Filter clamps- all filter cells and trays.....	screw compressions clamps
Filter Housing Material.....	304 SS
HEPA Cell efficiency % @ 0.3 u micron .....	99.99
Inlet Valve.....	4 in. ball valve stainless
Maximum number of troop Support .....	20
NBC Environment type.....	long-term
Operator's Manual.....	included
Power Storage.....	3456 watts@ 80% DOD
Pressure Gage 1 chamber 1.....	0-.5 in w.g.
Pressure Gage 2 chamber 2.....	0 -1 in w.g.
Pre-filter/Post filter .....	MERV 16 12 in x 24 in.
Residence time (RT) actual at 100 cfm.....	0.30
Residence time (RT) required seconds .....	0.25
Sealed Shelter Atmosphere .....	Lithium Hydroxide Cell
Shelf storage volume.....	25 ft <sup>3</sup>
Test Kit.....	ARMY M256A
Test Port.....	right side-visual
US DOD Defense Article Classification .....	CFR Title 22, 121.1 CAT 10
Weight - Filter Housing lbs.....	160
Weight - Filter Housing Stand lbs. ....	70

**SEAM 100 BREATHING AIR INCLUDES:**

1	Dual chamber stainless steel NBC filter housing
2	Chamber covers
1	Stainless housing stand with bottom shelf
2	100 cfm 24-Volt DC blower 45 watts/hr. = 1080 watts/day
2	Screw clamps to compress the filter elements
2	Pressure Gages with tubing and fittings -this needs to be assembled on site
1	Chemical Agent Test Port
1	4 in. Air Inlet Duct ball valve-mounted on unit or on ducts
1	4 in smooth bore x 25 ft air inlet hose and air manifold
3	Pre-filters
3	Post-filters
1	ASZM TEDA Carbon Cell
4	Change Out bags
1	ARMY M256 chemical agent detection kit.
1	Ratchet wrench and socket to operate filter element clamps
1	Operators Manual and Installation procedures for shelter and home room operation
1*	Principles of Protection Textbook, Walton McCarthy M.E. 6 <sup>th</sup> ed 2013 or 7 <sup>th</sup> ed 2023

\*Customers are expected to become familiar with the weapon effects listed in this textbook as a credible scientific source developed with a steering committee from the Dept of Energy, National Bureau of Standards, Strategic Applications Int'l, Federal Emergency Management, Nuclear Engineering Laboratory, Brookhaven National laboratory, and Oak Ridge National Laboratory.

**EMP SHIELDED GENERATOR PACKAGE PRIMARY COMPONENTS**

- GENMAX 6000 IED INVERTER GENERATOR SINE WAVE 118 LBS. DUAL FUEL GAS/PROPANE ELECTRIC/RECOIL START 120/240 VAC 5,250 running watts gas and 4750 watts propane, 63 dB @ 23 ft. 2 USB charging ports, <5% THD, gasoline 43 amps, propane 39.6 amps.
- Circuit Breaker Panel with breakers mounted
- EMP aluminum shielded enclosure for generator, battery regulator and battery charger.
- 2-180 AH carbon AGM batteries 127 lbs. each, does not produce hydrogen gas, no chips
- Customer needs to locally purchase an extension cord from generator to Seam 100
- Analog 24-volt battery meter
- The generator is to be located outside of the building, a minimum of 5 feet away from the building per NFPA 37.
- Generator Approximate Daily Duration to recharge the battery bank = 1.33 hrs.
- Generator has a 3.8 gal gasoline tank which needs to be filled manually after each tank is consumed.
- Duration of full battery bank is 3 days @ 20% SOC 23.7 volts
- 60 Amp 24-volt battery charger- stored in generator shielded housing.
- Propane stores for many years, is not explosive, needs no fuel pump, and is very clean.
- Gasoline stores for one year, is explosive, needs manual refueling, and is not clean.

PROPANE TANK	DIA. X HEIGHT	FILLED LBS	NET GAL	HRS OF OP	DAYS OF OP
				0.6 GPH @ 50%	
30 LB.	12.5 IN X 24 IN	55	7.3	12.2	9
40 LB.	12.5 X 29 IN.	72	9.7	16.2	12
100 LB.	14.7 IN X 48 IN.	170	24.3	40.6	30
420 LB.	30 IN . X 54.5 IN	626	102.2	170.3	128

Propane tanks are not included in this package. Customers must purchase their own propane tank(s).

GASOLINE GAL	L X W X H IN.	FILLED LBS	HRS OF OP.	DAYS OF OP
			0.45 GPH @ 50%	1.3 HRS/DAY
25	24 X 18 X 44 POLY	175	55	42
50	37 X 22 X 17 ALUM	350	778	84
100	54 X 24 X 20 ALUM	675	1500	167

Gasoline tanks are not included in this package. Customers must purchase their own fuel tank(s).

## EMP SHIELDED SOLAR POWER PACKAGE PRIMARY COMPONENTS



- 3- 200-WATT SOLAR PANELS 27 in. X 59 IN. X 1.5 in.
- 3 SOLAR PANEL STANDS ANGLE ADJUSTABLE 90 MPH RATING.
- 100 FT CABLE WITH CONNECTORS
- SOLAR CHARGE CONTROLLER-mounted on filter housing stand, -needs to be removed by the customer and stored in the EMP Shielded Enclosure.
- CIRCUIT BREAKER PANEL WITH BREAKERS- mounted on filter housing stand
- 2- 180 AH CARBON AGM BATTERIES 127 LBS EACH-mounted on lower shelf
- Analog 24-volt battery meter
- BATTERY CABLES
- BATTERY TEMP REGULATOR-needs to be removed and stored in EMP Shielded Enclosure
- 1-DISCONNECT
- EMP SHIELDED ENCLOSURE – to store solar panels, solar charge controller, and battery temperature regulator.

SOC %	VOLTS
100	26.6
80	25.9
60	25.2
40	24.4
20	23.7
0	23.0

### LITHIUM HYDROXIDE OPTION

A lithium hydroxide cell can be placed in the chamber to remove carbon dioxide from the air. This will allow recirculating the air inside the shelter without taking in air from outside the shelter. This would be useful if the shelterists choose not to bring in air during the first 24 hours after a nuclear detonation, saving the prefilter from radioactive fallout. It would also be useful if intruders find and cover the air intake manifold to force the shelterists out of the shelter. The lithium hydroxide tray can allow shelterists to safely operate inside the shelter for 1-5 days.



## SEAM 1000 CFM GENERATOR NBC AIR FILTRATION

Generators located inside an underground shelter must be located inside a special Non EMP Shielded Housing or an EMP Shielded Housing in compliance with EMP Shielding of MIL-188-125. The generator and NBC Air Filtration unit must operate under negative pressure located before the generator with a blower on the outflow of the generator housing. The unit below is designed to be powered directly by the generator with a manual valve on the air inlet and an automatic valve on the air outlet. The generator air filtration unit contains a pre-filter and a HEPA filter. Both can be changed using the Bag-In/Bag-Out system. The EMP shielded generator shown on the right has a 1000 cfm exhaust blower located in the air manifold at ground level. This draws the air through the air filter, under the floor, and then past the generator up to the air manifold exhaust blower. The air hoses are protected by EMP shielded air vents rated at 80+decibels for magnetic ( $SE_M$ ) and Resonant, ( $SE_R$ ) and the plane wave ( $SE_{PW}$ ).



SEAM 1000



EMP SHIELDED GENERATOR

## SHELTER IN PLACE (SIP) STATIONARY OR RE-DEPLOYABLE OPERATIONS

Troops Sheltering in Place (SIP) stationary or re-deployable, have enough power with either power package to operate LED lights, radios, TV, hot plates, DC water transfer pumps or 240V well pumps with the generator package, for over 90 days. The standard water formula of 1 gal/person/day, min. 1 lb.dry food/person/day, and portable sewage practices are required to be maintained.

## PLACING AN ORDER

1. Confirm that you have space in your shelter or in your house and that the 4-inch hose has a route to an exterior wall where the air inlet manifold needs to be installed.
2. Complete the Sales Order and End User Statement
3. All NBC Air Filtration units are shipped by power tailgate delivery trucks.
4. Wire or send a check for a 50% downpayment.
5. Farmscape Homes will email you an invoice showing your downpayment.
6. Delivery is usually 6 - 8 weeks.
7. One-week prior to shipping, you will receive a final invoice with shipping charges that must be paid prior to shipping.
8. The unit will ship fully insured on a flat pallet 4 ft wide x 5 ft long and 5.5 ft tall. The unit is assembled except for the pressure gages.
9. The unit must be checked for damages when received. If a damage report is not filed within three days of receiving the unit, the unit will be assumed to be received undamaged.