



# SE-shield

*Personal protective ensemble*

**S-HPS, S-VPS and S-PVC  
Encapsulated Suits**



## User instructions

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## **User Instructions for SE-shield Ensembles** **S-HPS, S-VPS and S-PVC Encapsulated Suits**

SE-shield is a range of SEA personal protective ensembles for use in hazardous environments.

Each SE-shield ensemble consists of a pressurised protective suit integrated with an S.E.A. FPBR (fan-supplied positive-pressure breath-responsive respirator). By directing a small amount of filtered air from the respirator into the suit via a special SE-shield breathing hose, positive pressure is maintained inside the suit. This provides added body protection and perceived cooling without reducing the respirator's high level of breathing protection.

***IMPORTANT! SE-shield suits should be used only by trained personnel and in accordance with these user instructions.***

***IMPORTANT! SE-shield suits should always be used with SE-shield pressurisation breathing hose and dual batteries.***

*Note: Refer to the SE400 User Instructions for proper use of the respirators.*

*Note (USA only): SE-shield suits are not approved as protective suits in the USA and have not been tested or approved by NIOSH as protection against any contaminants which may penetrate the suit and/or attack the skin.*

SE-shield encapsulated suits are available in three types:

### **SE-shield HPS – Domestic preparedness**

- Reusable, high performance encapsulated suit
- Suit material Trelleborg Trelchem<sup>®</sup> HPS is a combination of Du Pont Viton<sup>®</sup>/butyl rubber coated fabric on the outside and a polymer barrier laminate on the inside
- Impact and chemical resistant transparent PVC visor
- Integrated barrier film gloves with Viton<sup>®</sup>/butyl rubber outer gloves
- Recommended by SEA for domestic preparedness applications, with high permeation resistance to war agents such as mustard gas and Sarin

## SE-shield VPS – Domestic preparedness

- Reusable, vapour protective encapsulated suit
- Suit material Trelleborg Trelchem<sup>®</sup> VPS is a combination of chloroprene-rubber coated fabric on the outside and a polymer barrier laminate on the inside
- Impact and chemical resistant transparent PVC visor
- Integrated barrier film gloves with Viton<sup>®</sup>/butyl rubber outer gloves
- Recommended by SEA for domestic preparedness applications, with high permeation resistance to war agents such as mustard gas and Sarin

## SE-shield PVC – Biological

- Reusable, PVC-coated encapsulated suit
- Suit material polyamide fabric coated with PVC on both sides
- Impact and chemical resistant transparent PVC visor
- Integrated, chloroprene rubber gloves
- Recommended by SEA for protection against biological agents such as anthrax and smallpox

## Suit sizes

The suits are available in a range of sizes to suit the wearer, as follows:

Suit size	Wearer height cm (feet/inches)	Chest/bust cm (inches)
S	170–182 (5'7" –6'0")	88–96 (34" –38")
M	176–188 (5'9" –6'2")	92–100 (36" –39")
L	182–194 (6'0" –6'4")	96–104 (38" –41")
XL	188–200 (6'2" –6'7")	100–108 (40" –43")
XXL	200–212 (6'7" –6'11")	104–116 (41" –46")

*Note: Where a wearer's height and chest/bust dimensions give different suit sizes, use the larger suit size.*

## Unpacking

Each suit is packed with the following items:

- SE-shield suit
- Cotton inner gloves for comfort
- Rubber outer gloves with rubber band retainers (S-HPS and S-VPS only)
- Wax stick for zipper maintenance
- User instructions

## Storage

Store the suit hanging or folded in a cool, dry place. Avoid direct sunlight. Store the suit in a plastic bag. To prevent pressure damage, do not stack suits on top of one another, unless in individual cartons. If stored folded, the suit should be unfolded and inspected every 6 months when not in use.

Recommended storage life is 5 years for S-VPS, 7 years for S-HPS and 5 years for S-PVC, when stored as described above. In practice, life expectancy may exceed these recommendations.

The suit should be stored with the zipper fully open, or with at least approximately 10 cm open.

## Donning the suit

When donning the suit it is important to have an assistant.

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1. Fully assemble the respirator with SE-shield pressurisation breathing hose, backpack, SE-Talk, dual battery adaptor (not shown) and two fully charged batteries (see respirator user instructions). Position the fan unit on the back pack with the filter ports pointing downwards.



2. Undo the threaded nuts on the fan unit filter panel. Check that the seal is in place under each nut.



3. Insert the filter ports through the corresponding holes in the back of the suit.



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4. Refit the nuts and tighten firmly.



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5. Screw in the filters and tighten firmly. Fit pre-filters and pre-filter holders.



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6. Check that the zipper on the fan unit capsule of the suit is fully closed.



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7. Drape the assembled suit over a chair, hooking the filters over the backrest.



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8. Put on the inner gloves. Climb into the suit. Do not wear shoes.



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9. Put on the backpack. Fasten the waist belt and the chest strap.



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10. Roll up the protective aprons on the legs of the suit.



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11. Put on the outer boots.



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12. Fold the protective aprons down over the bootlegs.





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13. Sling the neck strap around your head.



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14. Put on the mask.



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15. To increase comfort and minimise visor fogging, turn on the fan unit by pressing either the control button on the speaker unit or the power switch on the fan unit.



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16. Put your arms through the sleeves of the suit and your hands into the gloves.



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17. Pull the suit over your head and pull the zipper all the way down (this is best done by your assistant).



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18. Fold the protective flap over the zipper and secure the Velcro tabs.



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19. (S-HPS and S-VPS only) Fit the rubber outer gloves.



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20. Fit the gauntlets around the cuff rings of the sleeves.



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21. Secure the gauntlets with rubber bands or tape.



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## Decontamination and doffing

Before doffing the suit, follow a decontamination procedure appropriate to the contaminant(s). Do not turn off the respirator or remove the filters until after decontamination.

After decontamination, remove the SE-shield ensemble in the reverse order to that described above. The respirator will shut down automatically shortly after the mask is removed from the face.

## **Cleaning**

- Use a mild detergent and a soft rag or smooth brush
- Take care not to scratch or damage the material
- Let the suit air-dry, or use a fan
- Stains of oil or other substances may be washed off with white spirit, then rinsed off with lukewarm water with a mild detergent, followed by clean water

## **Visual Inspection**

The suit should be inspected upon delivery, after each use, after each repair and, if unused, every six months.

The inspection should follow these steps:

1. Perform a visual inspection, both inside and out, looking for surface damage to material, seams, visor, and inner and outer gloves
2. Look for changes in material properties such as brittleness, stiffness, swelling, stickiness or other phenomena.
3. Check condition and function of zipper and zipper fitting
4. Check condition and function of exhaust valves, checking that they are firmly mounted

If any defect or malfunction is found, the suit must be removed from service.

Minor repairs may be done as described below. Any repairs not described in these User Instructions must be done by SEA or an SEA-authorized repairer.

## **Pressure testing**

Suits can be pressure tested using the SE-shield Pressure Test Kit, which consists of:

- Four exhaust valve blind plugs, one with test port
- Filter port blanking panel with nuts and gaskets
- Pressure gauge and connection hose

S-HPS and S-VPS suits should be tested with barrier film gloves fitted. Outer rubber gloves must be tested separately.

S-PVC suits should be tested with rubber outer gloves fitted. If secured with rubber bands, fit an extra rubber band to each glove to secure it during the test.

To prepare the suit for pressure testing, proceed as follows:

1. Remove all four exhaust valves from the suit.
2. Fit the four exhaust valve blind plugs in their place.
3. Fit the filter port blanking panel by removing the securing nuts from the panel, checking that the gaskets are intact, inserting the panel into the ports, and fitting and tightening the nuts.
4. Close the main zipper and the zipper above the filter ports.
5. Connect the pressure gauge to the test port.
6. Inflate the suit through the test port using an air pistol to a pressure of 1750 Pa / 17.5 mbar / 178 mm water column.
7. Lower the pressure to 1700 Pa / 17.0 mbar / 173 mm water column using the valve on the test port. This is the pre-test expansion pressure. Maintain this pressure for 10 minutes, adding air if necessary.
8. Adjust the pressure to 1650 Pa / 16.5 mbar / 168 mm water column. This is the test pressure. Set and start a timer and wait for 6 minutes. Do not touch the suit during this time. Record the pressure after 6 minutes. If the result is 1350 Pa / 13.5 mbar / 138 mm water column or more, the suit has passed the test.
9. After the test, remove the test equipment from the suit and refit the exhaust valves with their hoods.

If the suit fails the pressure test, it must be removed from service.

## **Replacement of gloves**

The barrier film gloves of the S-HPS and S-VPS suits and the rubber gloves of the S-PVC suits can be replaced by the same procedure.

To replace the gloves, proceed as follows:

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1. Before detaching the gloves, check the orientation of the thumbs to the suit sleeves.
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2. Detach the glove by pushing the inner glove and the cuff ring into the sleeve of the suit. A special tool is available to assist in this task.



3. Remove the tape, rubber band and glove from the cuff ring. It is good practice to cut the fingers off the discarded gloves to prevent accidental reuse.



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4. Pull off the rubber band and remove the glove from the cuff ring.



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5. Insert the new glove through the cuff ring and fold it back over the flange of the cuff ring.



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6. Double fold the glove gauntlet so that about 20 mm of the glove is covering the outside of the cuff ring. If necessary, the gauntlet of the new glove should be cut to a length which ensures a neat fit on the cuff ring without folds.



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7. Fit the rubber band over the glove gauntlet and push it against the flange of the cuff ring.



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8. Apply 25 mm PVC tape to secure the glove, so that half the width of the tape covers the glove and the other half sticks to the ring. Apply three full turns of tape onto the cuff ring, ensuring that one turn covers the rubber band.



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9. With the thumb of the glove oriented correctly to the suit sleeve, push the cuff ring into place.



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10. Pressure test the suit.
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Replace *both* gloves if the suit fails the pressure test, or if the gloves have been exposed to chemicals.



## Zipper handling and maintenance

S-PVC suits are fitted with a black chloroprene rubber zipper. S-HPS and S-VPS suits are fitted with a grey Viton<sup>®</sup> coated zipper which must be handled with great care.

### Zipper handling

**IMPORTANT!** Have someone help you open and close the zipper. Pull the slide with two fingers in the loop attached to the slide. Pull the slide parallel and straight along the zipper. Pulling sideways may seriously damage the zipper. When closing, make sure that neither suit material nor undergarment material is caught in the zipper. If the slide gets jammed or is hard to pull, pull it back, trace the reason and solve the problem. Then *slowly* try to close it again. Never try to overcome a problem by pulling harder, as this might damage the zipper.

### Zipper maintenance

The zipper must be lubricated every time the suit has been used and/or cleaned. Use the wax stick supplied with the suit. Frequent, light application of wax is better than infrequent, heavy application. See also separate instructions enclosed with the wax stick.

After cleaning, the sealing areas and metal parts must be re-waxed, inside and out. The grey Viton<sup>®</sup> coated zipper should also be greased slightly within the stop seal (where the slider is positioned when the zipper is completely closed) with the “Grease for Topstop-Sealing” supplied with suits with Viton<sup>®</sup> coated zippers.

## Retirement considerations

The suit must be replaced when worn out, damaged beyond repair, or after exposure to chemicals that cannot be decontaminated. If changes in the material properties (brittleness, stiffness, swelling, stickiness or other phenomena) are found, the suit should be taken out of service immediately and replaced. In doubt, contact SEA.

## Body Protection

SE-shield encapsulated suits are pressure tested to EN464/ prEN 943. This test is more stringent than ASTM F 1052 which is a requirement for Level A chemical suits, NFPA 1991.

## Permeation data

Chemical	S-HPS material breakthrough time (min.) <sup>1</sup>	S-VPS material breakthrough time (min.) <sup>1</sup>	Barrier film gloves breakthrough time (min.) <sup>2</sup>
<b>Chemical Warfare Agents</b>			
Mustard gas (HD)	>1440 <sup>3</sup>	>1440 <sup>3</sup>	>480 <sup>6</sup> (liquid)
Lewisite (L)	>1440 <sup>3</sup>	>1440 <sup>3</sup>	not tested
Tabun (GA)	>1440 <sup>3</sup>	>1440 <sup>3</sup>	not tested
Sarin (GB)	>1440 <sup>3</sup>	>1440 <sup>3</sup>	>480 <sup>7</sup> (liquid)
Soman (GD)	>1440 <sup>3</sup>	>1440 <sup>3</sup>	not tested
VX	>1440 <sup>3</sup>	>1440 <sup>3</sup>	not tested
Arsine (AS)	>480	>480	not tested
Phosgene (CG)	>480	>480	not tested
<b>Industrial chemicals</b>			
Acetic anhydride	>480	>480	>480
Acetone	>480	>480	>1440
Acetonitrile	>480	>480	>1440
Acrylic acid	>480	>480	>240
Aniline	>480	>480	>1440
Carbon disulfide 95%	>480	>480	>1440
Chlorine	>480	>480	>240
Chloroform	>480	>480	>1440
Dichloromethane	>480	>480	>480 <sup>4</sup>
Diethyl amine	>480	>480	>60
Diethyl ether	352	96	>480
Dimethyl formamide	>480	>480	>1440

Chemical	S-HPS material breakthrough time (min.) <sup>1</sup>	S-VPS material breakthrough time (min.) <sup>1</sup>	Barrier film gloves breakthrough time (min.) <sup>2</sup>
Epichlorohydrine	>480	>480	>240
Ethyl acetate	>480	>480	>1440
Ethylene glycol	>480	>480	>240
Ethylene oxide	>480	>480	>240
Formaldehyde 37%	>480	>480	>240
Formic acid 96%	>480	>480	120
Furfural	>480	>480	>480
Hexane	>480	>480	>1440
Hydrazine	>480	>480	>240 <sup>5</sup>
Hydrochloric acid 37%	>480	>480	>240
Hydrofluoric acid 48%	>480	>480	>240
Methanol	>480	>480	>480
Methyl ethyl ketone	>480	>480	>1440
Methyl methacrylate	>480	>480	>480
Nitric acid 65%	>480	>480	>40
Nitrobenzene	>480	>480	>1440
Nitromethane	>480	>480	>480
Phosphoric acid 85%	>480	>480	>240
Pyridine	>480	208	>480
Sodium hydroxide 40%	>480	>480	>480
Styrene	>480	216	>1440
Sulphuric acid 93%	>480	>480	>1440
Tetrachloroethylene	>480	>480	>1440
Tetrahydrofuran	>480	>480	>480
Toluene	>480	>480	>1440
Trichloroethylene	>480	>480	>1440
Vinyl acetate	>480	>480	>480
Vinyl chloride	>480	>480	>480

<sup>1</sup> Tested per ASTM F739, breakthrough criterion 0,1 µg/min/cm<sup>2</sup>, 25°C, test duration 8 hours.

<sup>2</sup> Tested per ASTM F739, breakthrough criterion 0,1 µg/min/cm<sup>2</sup>, 21°C.

<sup>3</sup> Tested per FINABEL Conv. 0.7.C at 37°C, test duration 24 hours.

<sup>4</sup> Dichloromethane 90%, Isopropyl alcohol 10%

<sup>5</sup> *Hydrazine 80%*

<sup>6</sup> *MIL-STD-282, Method 204.1.2*

<sup>7</sup> *MIL-STD-282, Method 206.1.3*

**For further information please contact SEA**



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