4. INTRODUCTION TO CB DECONTAMINANTS

This section provides an overview of the substances used for decontamination, that is, substances used to destroy, physically remove, or reduce CB agent or TIMs to an acceptable level. The two types of decontaminants are physical and chemical. Physical decontaminants include water, hot air, weathering, Fuller's Earth, and surfactants and are discussed in section 4.1. Chemical decontaminants include oxidizing agents, strong bases, and microemulsions and are discussed in section 4.2. Appendix F provides chemical decontaminant data sheets.

Additional information about planning and setting up decontamination operations is available in the *Terrorism Handbook for Operational Responders* (see app. B). The Decontamination chapter in the aforementioned handbook includes several appendices, one entitled Decontamination Solutions: Use and Preparation, and another that contains a flow/chart diagram of a complete decontamination corridor. It is important to note that the EPA has developed guidelines for how to handle contaminated runoff resulting from decontamination operations. This guidance letter is provided as appendix G. In addition to the EPA guidance letter, an EPA awareness document alerting first responders about the environmental liability due to mass decontamination runoff has been included in appendix H.

4.1 Physical Decontaminants

Physical decontaminants are substances used to remove CB contaminants from surfaces. Water, hot air, Fuller's Earth, weathering, and surfactants are examples of physical decontaminants and are explained in the remainder of this section. It should be noted that other decontaminants are necessary for neutralization of CB contaminants.

4.1.1 Water

Water is used to physically remove CB contaminants from surfaces. Water with the addition of detergents is effective for the decontamination of surfaces and materials contaminated with CB agent or TIMs. Decontamination by detergents and soaps in water occurs predominantly by the physical removal or dilution of agent. The use of soap and water for the physical removal of contaminants from skin and equipment will limit the spread of contamination.

Soap and water (especially soap and hot water) also has the capability to neutralize agents to some extent by the chemical method of slow hydrolysis. However, hydrolysis is limited due to the typically low solubility and slow rate of diffusion of agents in water. Contaminated surfaces may be wiped or scrubbed with hot, soapy water. If possible, the item may be immersed in soapy water; however, since soapy water does not detoxify CB contaminants, the runoff water must be considered contaminated and precautions must be undertaken to prevent additional CB contamination. The waste-water (from the water runoff) must be collected and treated to detoxify the agents.

High temperature saturated steam can also be employed to remove CB contaminants. Saturated steam is also used to remove grease and oil, as well as for sterilizing, disinfecting, degreasing, and degassing. Steam is efficient for cleaning surfaces before painting or other surface

treatments and will flush away poisons and chemicals, as well as dissolve resins and tars. It is ideal for de-icing applications, as well as for killing algae or mildew.

4.1.2 Hot Air

Hot air is used to physically remove CB contaminants from surfaces. The effectiveness of hot air decontamination varies with respect to the physical properties of the CB agent or TIM being decontaminated. For example, CB contaminants distributed over a nonporous or nonabsorbent surface are readily removed using heat. However, if the CB contaminants are distributed over a porous or absorbent surface, additional heat and time are required to fully remove it.

4.1.3 Fuller's Earth

Fuller's Earth is a nonplastic form of kaolin that contains an aluminum-magnesium silicate. The decontamination process involved with Fuller's Earth is the physical removal of the agent from surfaces. The term Fuller's Earth is typically applied to any clay that has an adequate purifying and/or decolorizing capacity. The most recognizable use for Fuller's Earth is kitty litter, a general purpose absorbent used for spill cleanups as well as for feline hygiene. Fuller's Earth is typically used in industry for decolorizing petroleum based oils, as a filler for rubber, as a substitute for activated charcoal, and as a filtering medium. Fuller's Earth may be used as a CB decontaminant if a better method for the decontamination/detoxification of chemical agents is unavailable. Crushed Fuller's Earth is best suited for personal decontamination, such as removing CB agent or TIMs from the skin of an exposed individual.

At some point, the contaminated Fuller's Earth will need to be subjected to a detoxification procedure. Caution must be exercised when using Fuller's Earth so as not to inhale the dust or fine particles associated with it, especially if it is contaminated with a CB agent or TIMs. Prolonged skin contact with Fuller's Earth may cause skin irritation. Inhalation of dust or fine particles may lead to an irritation/inflammation of the respiratory tract.

4.1.4 Weathering

Weathering describes a passive form of decontamination whereby natural sources of heat and UV radiation (sunlight), water (precipitation), and wind combine to decontaminate a vehicle, a piece of equipment, large structures, and large areas of terrain. During the weathering process, decontamination occurs by evaporation of the contaminant (physical removal) or destruction of contaminants by hydrolysis or, less likely, by photolysis (chemical reaction). The effectiveness of using weathering as a decontamination technology is very dependent on the persistency of the agent. The persistency of agent is dependent upon the wind speed, atmospheric stability, precipitation, terrain, vegetation, soil, method of dissemination, ambient temperature, and the material and surface on which the agent is deposited. Of these factors, wind, ambient temperature, humidity, precipitation, and atmospheric stability are the most important factors affecting agent persistency. High winds rapidly disperse chemical agent aerosols and vapors, thereby decreasing their effective coverage over the target. The higher the temperatures, the faster the agent will evaporate. In hot conditions without any wind, a significant vapor hazard can occur and decontamination by weathering will be much less effective. However, the

combination of high temperatures and moderate to high winds can be very effective in decontamination operations.

4.1.5 Surfactants

There are three categories of surfactants currently in use: anionic surfactants, cationic surfactants, and nonionic surfactants. The intent of a surfactant is not to detoxify the CB agent or TIMs but to solubilize it into a solution that can detoxify it. Anionic surfactants are generally more powerful in terms of solubilizing CB contaminants into an aqueous solution than cationic or nonionic surfactants.

4.2 Chemical Decontaminants

Chemical decontaminants are substances used to neutralize CB contaminants. Most of the current decontaminants used in the detoxification of CB contaminants can be considered reactive chemicals. Reactive chemicals are ones that readily react with another chemical without the need for stirring, heating, or shaking. Often, as in the case of hydrolysis or oxidation of chemical agents, the reactions occur immediately with the evolution of heat and gases (chlorine, water vapor, and hydrogen chloride (HCl)). Reactive compounds will interact with metallic containers and coated surfaces to corrode the surfaces, and with animal and vegetative tissues to damage the tissues. Three types of chemical decontaminants are oxidizing agents, strong bases, and microemulsions.

It should be noted that chemicals such as sodium hypochlorite (common bleach) and sodium hydroxide are effective decontaminants for both the removal and neutralization of CB contaminants.

4.2.1 Oxidizing Agents

Powerful oxidizing agents, such as calcium hypochlorite ($Ca(OCl)_2$) and sodium hypochlorite (NaOCl), are used effectively for the detoxification of CB contaminants. When $Ca(OCl)_2$ and NaOCl dissolve in water, the result is a solution that contains hypochlorite ions. The hypochlorite ions generated by an alkaline aqueous solution of $Ca(OCl)_2$ or NaOCl are effective in the decontamination of most CB contaminants.

Supertropical Bleach (STB) is a combination of powerful oxidizers ($Ca(OCl)_2$) and a strong base, calcium oxide (CaO). STB is effective in the decontamination/detoxification of HD, G agents, and VX. OCl^- generated by an aqueous solution of $Ca(OCl)_2$ and the hydroxide ion formed by the dissolution of CaO (which produces the OH^-) is effective in the decontamination/detoxification of G agents, VX, and HD. Hypochlorite ions in high pH solutions (alkaline) are less effective in the decontamination of VX due to reduced solubility of VX. When dissolved in water, calcium oxide forms calcium hydroxide ($Ca(OH)_2$).

Chloramine-B ($C_6H_5ClNNaO_2S$), also known commercially as Neomagnol, is an oxidant that is commonly used as an antibacterial agent. For use in decontaminating/detoxifying chemical agents, Chloramine-B is impregnated into a towelette and wetted with an aqueous solution of 5 % zinc chloride ($ZnCl_2$), 45 % ethanol, and 50 % water prior to use. Chloramine-B can be used as an

antibacterial agent (i.e., like Neomycin® Ointment) and as a topical antiseptic. Chloramine-B is effective in the decontamination/detoxification of HD and VX. However, Chloramine-B is apparently not effective against the G agents, nor against some biological agents. The detoxification of HD is a multi-step chemical process. Chloramine-B dissolves in water to form protonated Chloramine-B and free hydroxide ions. The zinc chloride maintains the pH of the environment between 5 and 6. At this point, the sulfur in the HD attacks the chlorine in the protonated Chloramine-B forming a transient chlorosulfonium ion species that reacts rapidly with the $C_6H_5SO_2N^-H$ anion to form a sulfimide species and with water to form sulfur mustard. For VX, it was found that VX does not react with the Chloramine-B in the towelette because the pH of the decontamination solution increases in the presence of the VX. It is believed that in actual use, the VX is physically removed from the surface by the action of wiping down the surface and by concurrent solubilization of the VX.

4.2.2 Strong Bases

Strong bases, such as CaO, $Ca(OH)_2$, sodium hydroxide (NaOH), and potassium hydroxide (KOH), produce a high concentration of hydroxide ions upon mixing with water. These compounds, when in solution, are effective hydrolyzing agents in reacting with chemical agents. Sodium hydroxide is the most widely used base in a solution since it has the highest solubility of these compounds; calcium oxide and calcium hydroxide are the least soluble.

NaOH is applicable for the detoxification of persistent agents and G agents where the main reaction is alkaline hydrolysis. In the reaction with GB, the hydroxide bond disrupts and breaks the phosphorus-fluorine bond and forms a phosphorus-oxygen bond. The hydroxide ion is not as effective for VX as it is for GB. In VX, the critical bond is the phosphorus-sulfur bond. While the hydroxide ion will break the P - S bond, there is a competing reaction that replaces the ethoxy group with a hydroxyl group, forming a compound called EA2192. This compound is comparable to VX in its toxicity. Depending on the conditions, up to 14 % of EA2192 will be produced. In addition, the solubility of VX in a basic solution such as hydroxide is low, which will affect the reaction rate at low (room) temperature. The hydroxide ion can also be used to detoxify mustard, HD. In the reaction with HD, the hydroxide ion replaces the chlorine atom producing hydrochloric acid. The solubility of HD in an aqueous system, such as hydroxide, is low and much of the reaction occurs at the interface between the HD and water. Normally, the reaction rate is much too slow to be a viable detoxification method. Techniques often used to increase the reaction rate include stirring the reaction mixture and increasing the temperature to around 100 °C.

Strong bases such as sodium hydroxide (NaOH) can also dissolve into an organic solvent forming a very strong basic solution. The most well known member of this technology is Decontaminating Solution Number 2 or DS2. This solution is made up of 70 % diethylenetriamine (DETA), 28 % 2-methoxyethanol (also known as ethylene glycol monomethylether, EGME), and 2 % NaOH. In this solution, NaOH reacts with EGME forming the ethoxide; when DETA is added to this solution, any free sodium ions are rapidly bound up by the DETA. This causes the hydroxide ions to be highly reactive, effectively increasing the strength of the basic solution.

DS2 was formulated to be a general purpose reactive decontaminant that would be ready to use over a large temperature range, and have long-term storage stability. DS2 reacts instantly with the G

agents, VX, and HD at ambient temperatures. DS2 is noncorrosive to most metals, but it can damage paints, plastics, rubbers, and leather materials. DS2 is flammable and cannot be used in conjunction with strong oxidizing agents such as bleach, which cause it to spontaneously combust. DS2 comes ready to use in containers ranging from 1–1/3 quart cans to 5–gallon pails. Application of DS2 can be by the ABC-M11 portable decontamination apparatus or the M13 DAP. DS2 is allowed to remain in contact with the contaminated surface for up to 30 min, and then rinsed off with water. DS2 is most effective when application is followed by a scrubbing action. It should be noted that DS2 is being replaced because of its damaging effects to the environment. It should also be noted that BX24 is a decontaminant that is currently undergoing testing as an interim replacement for DS2. BX24 is a powder that easily mixes with water and is commercially available from Cristanini SpA.

4.2.3 Microemulsions

Chemical agents are organic compounds that exhibit a limited solubility in water. Many decontaminants, such as calcium hypochlorite and sodium hydroxide, are highly soluble in water. Because of the limited solubility of chemical agents in water, the time needed to decontaminate the agent is determined primarily by the solubility of the agent in the mixture of water and decontaminant. Microemulsions are thermodynamically stable mixtures of water, oil, surfactants, and co-surfactants that appear macroscopically as a homogeneous phase. Different water-soluble decontaminants can be dissolved into a microemulsion leading to a chemical system containing very small organic droplets dispersed into water (for an oil in water microemulsion) containing the decontaminant. When a chemical agent encounters a microemulsion system, it is partially dissolved (partitioned) into the organic phase of the microemulsion. Once dissolved, the agent can react with the water-soluble decontaminant at the surface of the organic portion of the microemulsion. The rate of agent decontamination is related to the size of the microemulsion particles. The smaller the particles in a microemulsion, the faster the decontamination process. This is due to the high surface area of the reaction surface with respect to the amount of chemical agent dissolved, and the short diffusion paths from the center of the microemulsion particle to its surface.

C8 is a microemulsion formulated by the Alfred Karcher Gmbh & Company in Germany as a multipurpose decontaminant reagent. The C8 emulsion consists, by weight, of 15 % tetrachloroethylene (C_2Cl_2) which serves as the continuous phase, 76 % water, 1 % anionic surfactant, and 8 % $Ca(OCl)_2$. C8 is effective in the decontamination of VX, G agents, and HD. C8 can penetrate into paint (without damaging the paint) in order to dissolve and react with chemical agents that may be imbedded inside the paint. When sprayed, C8 forms a thin, continuous film over the surface to allow for sufficient contact time in decontaminating/detoxifying the chemical agents. After decontamination, the C8 can be rinsed off with water.

5. OVERVIEW OF EMERGENCY FIRST RESPONDER INITIATIVES FOR CB DECONTAMINATION

To prepare for a CB attack, several municipalities have instituted new methods and policies concerning mass decontamination. Past decontamination procedures were effective in treating small numbers but the threat of the use of CB weapons of mass destruction has forced the development of mass decontamination capabilities that address the needs of the civilian population. Moreover, private contractors are playing a key role in developing new technologies to make mass decontamination a more expedient, safe, and private chore. Unfortunately, many of these technologies are expensive, and many first responder jurisdictions do not have sufficient funds to employ the implementation of mass decontamination trailers. Only a limited number of first responder organizations have purchased decontamination trailers for mass decontamination purposes due to their high costs.

As an alternative to purchasing a trailer, several first responder communities have taken the initiative to invent, design, contract, and implement their own mass decontamination apparatus and procedures. By taking this "in house" approach, the jurisdiction can implement ideas and procedures they know work and then build units to accommodate their own needs at lower cost. One such jurisdiction that has taken the initiative to fabricate its own trailer is the Boston Fire Department (app. D).

6. SELECTION FACTORS

This section discusses 13 factors emergency first responders should consider when selecting and purchasing CB decontami-nation equipment. These factors were compiled by a panel of experienced scientists and engineers with multiple years of experience in decontamination, domestic preparedness, and identification of emergency first responder needs. The factors have also been shared with the emergency first responder community in order to obtain their thoughts and comments. It is anticipated that as additional input is received from the emergency first responder community, additional factors may be added or existing factors may be modified. These factors were developed so that CB decontamination equipment could be compared and contrasted in order to assist with the selection and purchase of the most appropriate equipment. It is important to note that the evaluation conducted using the 13 selection factors was based upon vendor-supplied data and no independent evaluation of equipment was conducted in the development of this guide. The vendor-supplied data can be found in its entirety in Volume II of this guide.

The results of the evaluation of the decontamination equipment against the 13 selection factors are provided in section 7. The remainder of this section defines each of the selection factors. Details on the manner in which the selection factor was used to assess the equipment are presented in table 6–1.

6.1 Chemical Agents Decontaminated

This factor describes the ability of the equipment to decontaminate chemical agents. Chemical agents, when referred to in this guide, refer to nerve and blister agents only. Blood agents and choking agents are included within the list of TIMs. Nerve agents primarily consist of GB and VX. Other nerve agents include GA, GD, and GF. Blister agents are primarily limited to mustard (H). Other blister agents considered in this guide include HD, HN, and L.

6.2 Biological Agents Decontaminated

This factor describes the ability of the equipment to decontaminate biological agents. Biological agent types considered for this guide include bacteria (i.e. Anthrax), rickettsia (i.e., Typhus), toxins (i.e., Botulinum Toxin), and viruses (i.e., Q Fever).

6.3 TIMs Decontaminated

This factor describes the ability of the equipment to decontaminate TIMs. TIMs considered, in the development of this guide, are discussed in section 2.

6.4 Functional Application

Functional application describes the areas where a piece of equipment would best be employed in the event of a chemical agent, biological agent, or a TIM attack. The three application areas are personnel, equipment, and infrastructure.

6.5 Capacity/Throughput

Capacity/throughput will be determined by the functional application of the decontamination equipment. This describes how many people (e.g., skin and protective equipment), large equipment (e.g., vehicles), small equipment (e.g., computers and communication equipment), and the areas within an infrastructure that a piece of decontamination equipment can clean in a specific time (e.g., per hour). It should be noted that the relevancy of this factor depends on the initial and operating cost of the decontamination equipment.

6.6 Effectiveness of Decontamination

Effectiveness of decontamination describes the ability of the equipment to decontaminate chemical agents and biological agents. Decontamination is defined as the process of removing or neutralizing a surface hazard resulting from a chemical agent, biological agent, or a TIM attack. For example, some decontamination equipment is only capable of physically removing a surface hazard while other items are capable of removing and neutralizing the surface hazard.

6.7 Set-Up Time

This factor describes the amount of time required to ready the equipment for decontamination operations. The time includes setting up, processing, and tearing down the equipment.

6.8 Power Capabilities

The power capabilities describes the type of power (AC, DC, etc.) required to operate a piece of equipment.

6.9 Operational Environment

This factor describes the type of environment required for the decontamination system to be used optimally. For example, some decontamination systems are capable of operating in a field under common outdoor weather conditions and climates, e.g., rain, snow, extreme temperatures, humidity, etc. However, other decontamination systems may require more controlled conditions.

6.10 Durability

Durability describes ruggedness of the equipment, i.e., how well a piece of equipment can take rough handling in harsh environments.

6.11 Resources

Resources describe the amount of manpower required to use a decontamination system (i.e., mixing, applying, and rinsing).

6.12 Operator Skill Level

Operator skill level refers to the skill level and training required for the operation of an instrument.

6.13 Training Requirements

This factor considers the amount of time required to instruct the operator to become proficient in the operation of the equipment.

Table 6-1. Selection factor key for decontamination equipment

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	Chemical Agents Decontaminated	Biological Agents Decontaminated	TIMs Decontaminated	Functional Applications	Capacity/ Throughput	Effectiveness of Decontamination	Set-Up Time	Power Capabilities	Operational Conditions	Durability	Resources	Operator Skill Level	Training Requirements
●	Decontaminates all nerve and blister agents	Decontaminates all biological agents	Decontaminates all of the TIMs listed	Decontaminates all application areas	More than 500 personnel; 20 large or 100 small pieces of equipment; or 10000 sq ft of area	Capable of neutralization and physical removal of contaminants	Less than 30 min	No power required	Operates in all expected environments	Capable of operating in harsh environments	One individual is required to use the decontamination system	No special skills or training required	No special training required
◕		Decontaminates multiple biological agents		Decontaminates multiple application areas	From 100 to 500 personnel; 10 to 20 large or 50 to100 small pieces of equipment; or 5000 to 10000 square feet of area	Capable of neutralization but not physical removal of contaminants	From 30 min to 60 min	Vehicle or AC powered	Operates in most environments				
◑	Decontaminates either the nerve or blister agent class	Decontaminates only one biological agent	Decontaminates multiple TIMs	Decontaminates at least one of the application areas	From 50 to 100 personnel; 5 to 10 large or 25 to 50 small pieces of equipment; or 2500 to 5000 sq ft of area	Capable of physical removal but not neutralization of contaminants	From 60 min to 120 min	AC powered	Operation is restricted to certain environments	Operation is restricted to certain environments	Two people are required to use the decontamination system	No special skills but training required	Less than 8 h training required
◔			Decontaminates only one TIM										
○	Decontaminates none of the nerve or blister agents	Decontaminates no biological agents	Decontaminates none of the TIMs listed	Decontaminates none of the application areas	Less than 50 personnel; 5 large or 25 small pieces of equipment; or 2500 sq ft of area	Not capable of physical removal or neutralization of contaminants	Greater than 120 min	Other power sources such as diesel engines, electrical generators, etc	Operates only at room temperature	Not capable of operating in harsh environments	More than two people are required to use the decontamination system	Technician required to operate equipment	More than 8 h training required

The blank cells designate that the symbol is not applicable for the selection factor.
A duplicate of this table is provided for quick reference (as Table 7-6).

7. DECONTAMINATION EQUIPMENT EVALUATION

The market survey conducted for CB agent and TIM decontamination identified 72 different pieces of equipment. The details of the market survey to include data on each piece of equipment are provided in Volume II of this guide. This section documents the results of evaluating each equipment item versus the 13 selection factors. Section 7.1 defines the functional applications of the equipment and section 7.2 discusses the evaluation results.

7.1 Functional Application Categories

In order to display the evaluation results in a meaningful format, the decontamination equipment was grouped into three categories based on the functional application of the equipment or areas where a piece of equipment would best be employed by the emergency first responder community. The three application areas are personnel, equipment, and infrastructure.

The definitions for the three usage categories were extracted from the *Final Report: Wide Area Decon: CB Decontamination Technologies, Equipment and Projects* (see app. B). The definitions for each of the usage categories are as follows:

- **Personnel.** Equipment designed to decontaminate either individuals or large populations. The means of decontamination is not harmful to the human body. It also refers to the ability to decontaminate CB agents or TIMs on personal equipment that is carried by the emergency first responder.

- **Equipment.** Equipment designed to decontaminate large and small equipment items without affecting the usefulness of the items. Equipment decontamination can include sensitive equipment decontamination (e.g., computers, communications equipment), exterior equipment decontamination (e.g., vehicles), and interior equipment decontamination.

- **Infrastructure.** Equipment specifically designed to decontaminate large areas of land and terrain as well as large-scale items such as roadbeds, airstrips, cargo loading docks, and multiple buildings.

7.2 Evaluation Results

There were 72 separate decontamination equipment items identified. The evaluation results for CB agent and TIM decontamination equipment are presented in tabular format for the 72 pieces of equipment identified at the time of the writing of this guide. A table is presented for each of the three usage categories. Each table includes the specific equipment and the symbol that corresponds to how the equipment item was characterized based upon each of the selection factor definitions. The acronym ‘TBD’ is displayed in the appropriate cell if data were not available to characterize a specific selection factor. The acronym “NA” is displayed in the appropriate cell if the data were not applicable for a piece of equipment. Table 7-1 provides the table number and associated table pages for each of the usage categories.

Table 7–1. Evaluation results reference table

Table Name	Table Number	Page(s)
Personnel	7–3	41-45
Equipment	7–4	46–51
Infrastructure	7–5	52
Selection Factor Key	7–6	53

It should be noted that of the 72 decontamination items identified, 24 equipment items have multiple decontamination applications. The total available applications, separate and combined, is 100 applications.

There were 40 personnel decontamination equipment items identified. Of these 40 items, 20 were limited to one function application, 16 were capable of two function applications (personnel and equipment), and 4 had three function applications.

There were 51 equipment decontamination items identified. Of the 51 items, 27 were limited to one function application, 20 were capable of two function applications (16 were equipment and personnel and 4 were equipment and infrastructure), and 4 had three function applications.

There were 9 infrastructure decontamination equipment items identified. Of the 9 items, 1 was limited to one function application, 4 were capable of two function applications (infrastructure and equipment), and 4 had three function applications.

Refer to table 7–2 for a summary of the decontamination applications of the identified equipment.

Table 7–2. Decontamination applications

Equipment Type	Decontamination Capability			
	One functional application	Two functional applications	Three functional applications	Total applications
Personnel	20	16	4	40
Equipment	27	20	4	51
Infrastructure	1	4	4	9
Total Capabilities	**48**	**40**	**12**	**100**

Table 7-3. Personnel decontamination equipment

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ID #	Equipment Name	Chemical Agents Decontaminated	Biological Agents Decontaminated	TIMs Decontaminated	Functional Applications	Capacity/Throughput	Effectiveness of Decontamination	Set-Up Time	Power Capabilities	Operational Conditions	Durability	Resources	Operator Skill Level	Training Requirements
1	Skin Decontaminant Lotion	●	TBD	TBD	◕	TBD	◕	TBD	●	●	TBD	●	●	●
11	NBC-DEWDECON-PERS Emergency Response Personnel Decontamination Kit	●	TBD	TBD	◑	TBD	●	●	●	TBD	●	●	●	●
16	M17 Lightweight Decontamination System, Sanator	●	●	TBD	◕	TBD	●	TBD	○	●	TBD	●	●	●
17	DECON Powder Glove	●	TBD	TBD	◑	TBD	◑	TBD	●	◑	TBD	●	○	TBD
18	Personal Decontamination Kit	●	TBD	TBD	◑	○	●	TBD	●	◕	●	●	◑	◑
19	SDMS Sensitive Material Decontamination System	●	TBD	TBD	◕	◑	●	TBD	◕	◕	●	○	◑	○
21	Mobile Decon Pad	TBD	TBD	TBD	◑	TBD	◑	○	TBD	TBD	●	TBD	TBD	TBD
23	Portaflex CUPOLA Decontamination Shelter	TBD	TBD	TBD	◑	TBD	●	●	●	TBD	TBD	TBD	TBD	TBD

'TBD' (to be determined) - there are no data currently available to support that selection factor.
'NA' - the specific selection factor is not applicable for the piece of equipment.
See Table 7-6 for selection factor definitions.

Table 7-3. Personnel decontamination equipment

September 2000

ID #	Equipment Name	Chemical Agents Decontaminated	Biological Agents Decontaminated	TIMs Decontaminated	Functional Applications	Capacity/Throughput	Effectiveness of Decontamination	Set-Up Time	Power Capabilities	Operational Conditions	Durability	Resources	Operator Skill Level	Training Requirements
24	Portaflex Decontamination Shower Series	●	●	TBD	◑	TBD	◑	●	TBD	TBD	TBD	TBD	●	●
25	Response and Decontamination Unit	TBD	TBD	TBD	◑	TBD	●	TBD	○	TBD	TBD	TBD	TBD	TBD
30	COLPRO	●	TBD	TBD	◕	TBD	●	◕	◑	◕	●	○	◑	○
31	Decon System for Sensitive Materials (DSSM)	●	●	TBD	◕	TBD	◕	TBD	○	◕	●	○	○	○
32	Field Shower System	●	●	TBD	◑	TBD	◑	◕	●	◕	●	●	●	◑
33	Karcher Decojet-Trailer Decontamination System	●	●	TBD	●	◑	◑	TBD	TBD	●	●	TBD	○	○
34	Mediclean	●	●	TBD	◑	TBD	●	●	TBD	◕	●	●	◑	◑
35	Mobile Environmental Protection Container	●	●	TBD	◕	○	◑	TBD	○	◕	●	◑	○	○

'TBD' (to be determined) - there are no data currently available to support that selection factor.
'NA' - the specific selection factor is not applicable for the piece of equipment.
See Table 7-6 for selection factor definitions.

Table 7-3. Personnel decontamination equipment

September 2000

ID #	Equipment Name	Chemical Agents Decontaminated	Biological Agents Decontaminated	TIMs Decontaminated	Functional Applications	Capacity/Throughput	Effectiveness of Decontamination	Set-Up Time	Power Capabilities	Operational Conditions	Durability	Resources	Operator Skill Level	Training Requirements
36	Karcher DT60 Decontamination Tent	●	●	TBD	◕	◕	◑	●	●	●	TBD	◑	●	◑
37	Karcher SCS 1200 DE Lightweight Decontamination System	●	●	◑	◕	TBD	◑	TBD	○	●	●	●	●	◑
40	Karcher DECOCONTAIN 3000 Decontamination System	●	●	◑	●	◕	●	TBD	◕	●	●	◑	○	○
41	Karcher Decontamination Trailer	●	●	TBD	◕	TBD	●	TBD	TBD	●	●	TBD	●	○
42	Karcher SCS 1800 DE Decontamination System	●	●	TBD	◕	TBD	●	TBD	○	●	●	●	●	◑
43	Karcher Decojet Decontamination System	TBD	TBD	TBD	◕	TBD	●	TBD	TBD	●	●	TBD	●	◑
44	Karcher DECOCONTAIN 1500 Decontamination System	●	●	TBD	●	◕	●	TBD	TBD	●	TBD	TBD	○	○
47	Karcher Decont Tent	●	●	TBD	◕	TBD	◑	●	●	●	●	◑	TBD	◑

'TBD' (to be determined) - there are no data currently available to support that selection factor.
'NA' - the specific selection factor is not applicable for the piece of equipment.
See Table 7-6 for selection factor definitions.

Table 7-3. Personnel decontamination equipment

September 2000

ID #	Equipment Name	Chemical Agents Decontaminated	Biological Agents Decontaminated	TIMs Decontaminated	Functional Applications	Capacity/Throughput	Effectiveness of Decontamination	Set-Up Time	Power Capabilities	Operational Conditions	Durability	Resources	Operator Skill Level	Training Requirements
50	Karcher MPDS MultiPurpose Decontamination System	●	●	◑	◕	TBD	◑	TBD	○	●	●	TBD	TBD	TBD
51	Karcher Hot Air Generator FB 20	TBD	TBD	TBD	◕	TBD	◑	TBD	◑	●	●	TBD	●	◑
55	Decon Hoop	●	●	TBD	◕	TBD	◑	●	●	TBD	●	TBD	●	●
56	SNL Decon Formulation	●	●	TBD	●	NA	◕	●	●	●	●	●	●	●
57	Reactive Skin Decontaminant Lotion (RSDL)	●	◕	TBD	◕	NA	◕	●	●	◑	◑	●	●	●
58	PLYCHEM DECAS Decontamination Unit	TBD	TBD	◑	◑	○	◑	◕	●	◕	●	◑	◑	◑
59	PLYCHEM DPI Decontamination Unit	TBD	TBD	◑	◑	○	◑	◕	●	◕	●	◑	◑	◑
60	Modular Mass Casualty Decontamination System	TBD	TBD	TBD	◑	○	●	●	TBD	●	TBD	○	TBD	TBD

'TBD' (to be determined) - there are no data currently available to support that selection factor.
'NA' - the specific selection factor is not applicable for the piece of equipment.
See Table 7-6 for selection factor definitions.

Table 7-3. Personnel decontamination equipment

September 2000

ID #	Equipment Name	Chemical Agents Decontaminated	Biological Agents Decontaminated	TIMs Decontaminated	Functional Applications	Capacity/Throughput	Effectiveness of Decontamination	Set-Up Time	Power Capabilities	Operational Conditions	Durability	Resources	Operator Skill Level	Training Requirements
61	Decontamination Kit, Personal No 1 Mark 1	●	TBD	TBD	◑	TBD	◑	TBD	●	TBD	TBD	●	●	●
62	Decontamination Kit, Personal No 2 Mark 1	●	TBD	TBD	◑	TBD	◑	TBD	●	TBD	TBD	TBD	●	●
63	Hazmat Decon Shower	●	●	TBD	◑	TBD	●	●	●	◔	◑	●	●	●
64	Hazmat Decon Backboard	●	●	TBD	◑	TBD	●	TBD	●	TBD	TBD	TBD	●	●
68	Decontamination Kit No 2	●	●	TBD	◑	○	◑	TBD	●	●	TBD	●	●	●
69	Decontamination Kit, Individual Equipment: M295	TBD	TBD	TBD	◑	TBD	●	TBD	●	TBD	TBD	●	●	●
70	TVI Quick-E WMD Decon Shower Shelter	TBD	TBD	TBD	◑	TBD	◑	●	TBD	●	●	◑	TBD	TBD
71	TVI Quik-Kleen Mass Decontamination System	TBD	TBD	TBD	◑	TBD	●	TBD	TBD	●	●	TBD	TBD	TBD

'TBD' (to be determined) - there are no data currently available to support that selection factor.
'NA' - the specific selection factor is not applicable for the piece of equipment.
See Table 7-6 for selection factor definitions.

Table 7-4. Equipment decontamination systems

September 2000

ID #	Equipment Name	Chemical Agents Decontaminated	Biological Agents Decontaminated	TIMs Decontaminated	Functional Applications	Capacity/Throughput	Effectiveness of Decontamination	Set-Up Time	Power Capabilities	Operational Conditions	Durability	Resources	Operator Skill Level	Training Requirements
1	Skin Decontaminant Lotion	●	TBD	TBD	◕	TBD	◕	TBD	●	●	TBD	●	●	●
2	K1-05 Standard Unit	TBD	TBD	TBD	◑	TBD	◑	TBD	◕	TBD	TBD	TBD	TBD	TBD
3	K4-05 High Purity	TBD	TBD	TBD	◑	TBD	◑	TBD	TBD	TBD	TBD	TBD	TBD	TBD
4	Snow Motion	TBD	TBD	TBD	◑	TBD	◑	TBD	TBD	◑	TBD	TBD	TBD	TBD
5	Decontamination Glove Booths	TBD	TBD	TBD	◑	TBD	◑	TBD	TBD	TBD	◑	TBD	TBD	TBD
6	HAL Series	●	TBD	TBD	◑	TBD	◑	TBD	TBD	◕	TBD	TBD	TBD	TBD
7	The Optimum Console	TBD	TBD	TBD	◑	TBD	◕	TBD	TBD	TBD	●	TBD	TBD	TBD
8	Ice Gun	TBD	TBD	TBD	◑	TBD	◑	TBD	●	TBD	TBD	TBD	●	◑
9	Cryogenesis Booth	●	●	TBD	◑	TBD	◑	◕	●	TBD	TBD	TBD	●	◑

'TBD' (to be determined) - there are no data currently available to support that selection factor.
'NA' - the specific selection factor is not applicable for the piece of equipment.
See Table 7-6 for selection factor definitions.

Table 7-4. Equipment decontamination systems

September 2000

ID #	Equipment Name	Chemical Agents Decontaminated	Biological Agents Decontaminated	TIMs Decontaminated	Functional Applications	Capacity/Throughput	Effectiveness of Decontamination	Set-Up Time	Power Capabilities	Operational Conditions	Durability	Resources	Operator Skill Level	Training Requirements
10	Delta V-1 Dry Ice Surface Cleaning System	●	●	TBD	◑	TBD	●	TBD	TBD	TBD	TBD	TBD	TBD	TBD
12	NBC-DEWDECON-M Decontaminant Mixer/ Applicator	●	●	TBD	◑	TBD	●	●	TBD	TBD	TBD	◑	TBD	TBD
13	NBC-DEWDECON-2L	●	●	TBD	◑	TBD	●	TBD	TBD	TBD	TBD	TBD	TBD	TBD
14	NBC-DEWDECON-3L Decontamination Device	●	●	TBD	◑	TBD	●	TBD	TBD	TBD	●	TBD	TBD	TBD
15	NBC-DEWDECON-20L Decontamination Device	●	●	TBD	◑	TBD	●	TBD	TBD	TBD	◑	TBD	TBD	TBD
16	M17 Lightweight Decontamination System, Sanator	●	●	TBD	◕	TBD	●	TBD	○	●	TBD	●	●	●
19	SDMS Sensitive Material Decontamination System	●	TBD	TBD	◕	◑	●	TBD	◕	◕	●	○	◑	○
20	Thorough Decontamination System	●	TBD	TBD	◑	◑	●	TBD	TBD	◕	TBD	○	○	○
22	Mobile Laboratories	TBD	TBD	TBD	◑	TBD	◑	TBD	◑	TBD	TBD	TBD	TBD	TBD

'TBD' (to be determined) - there are no data currently available to support that selection factor.
'NA' - the specific selection factor is not applicable for the piece of equipment.
See Table 7-6 for selection factor definitions.

Table 7-4. Equipment decontamination systems

September 2000

ID #	Equipment Name	Chemical Agents Decontaminated	Biological Agents Decontaminated	TIMs Decontaminated	Functional Applications	Capacity/Throughput	Effectiveness of Decontamination	Set-Up Time	Power Capabilities	Operational Conditions	Durability	Resources	Operator Skill Level	Training Requirements
26	Blast Guard	●	●	TBD	◕	TBD	●	●	◕	◑	●	○	○	○
27	First Responder's Blast Guard	●	●	TBD	◕	TBD	●	●	●	◑	●	◑	○	○
28	First Responder's Surface Decon Unit	●	●	TBD	◑	◑	●	●	◕	◕	●	◑	●	◑
29	CASCAD	●	●	TBD	◑	●	●	●	◕	◕	●	○	●	◑
30	COLPRO	●	TBD	TBD	◕	TBD	●	◕	◑	◕	●	○	◑	○
31	Decon System for Sensitive Materials (DSSM)	●	●	TBD	◕	TBD	◕	TBD	○	◕	●	○	○	○
33	Karcher Decojet-Trailer Decontamination System	●	●	TBD	●	◑	◑	TBD	TBD	●	●	TBD	○	○
35	Mobile Environmental Protection Container	●	●	TBD	◕	○	◑	TBD	○	◕	●	◑	○	○
36	Karcher DT60 Decontamination Tent	●	●	TBD	◕	◕	◑	●	●	●	TBD	◑	●	◑

'TBD' (to be determined) - there are no data currently available to support that selection factor.
'NA' - the specific selection factor is not applicable for the piece of equipment.
See Table 7-6 for selection factor definitions.

Table 7-4. Equipment decontamination systems

September 2000

ID #	Equipment Name	Chemical Agents Decontaminated	Biological Agents Decontaminated	TIMs Decontaminated	Functional Applications	Capacity/Throughput	Effectiveness of Decontamination	Set-Up Time	Power Capabilities	Operational Conditions	Durability	Resources	Operator Skill Level	Training Requirements
37	Karcher SCS 1200 DE Lightweight Decontamination System	●	●	◑	◕	TBD	◑	TBD	○	●	●	●	●	◑
38	Karcher HDS 1200 EK High-Pressure Steam Jet Cleaner Unit	●	●	◑	◑	TBD	●	TBD	TBD	●	●	TBD	●	◑
39	Karcher Decont Jet 21	TBD	TBD	TBD	◑	◕	●	TBD	TBD	●	●	◑	◑	○
40	Karcher DECOCONTAIN 3000 Decontamination System	●	●	◑	●	◕	●	TBD	◕	●	●	◑	○	○
41	Karcher Decontamination Trailer	●	●	TBD	◕	TBD	●	TBD	TBD	●	●	TBD	●	○
42	Karcher SCS 1800 DE Decontamination System	●	●	TBD	◕	TBD	●	TBD	○	●	●	●	●	◑
43	Karcher Decojet Decontamination System	TBD	TBD	TBD	◕	TBD	●	TBD	TBD	●	●	TBD	●	◑
44	Karcher DECOCONTAIN 1500 Decontamination System	●	●	TBD	●	◕	●	TBD	TBD	●	TBD	TBD	○	○
45	Karcher Mobile Field Laundry CFL 60	TBD	TBD	TBD	◑	◑	◑	TBD	○	●	TBD	TBD	●	◑

'TBD' (to be determined) - there are no data currently available to support that selection factor.
'NA' - the specific selection factor is not applicable for the piece of equipment.
See Table 7-6 for selection factor definitions.

Table 7-4. Equipment decontamination systems

September 2000

ID #	Equipment Name	Chemical Agents Decontaminated	Biological Agents Decontaminated	TIMs Decontaminated	Functional Applications	Capacity/Throughput	Effectiveness of Decontamination	Set-Up Time	Power Capabilities	Operational Conditions	Durability	Resources	Operator Skill Level	Training Requirements
46	Karcher C8-DADS Direct Application Decontamination System	●	●	◑	◕	TBD	●	TBD	○	●	●	TBD	●	◑
47	Karcher Decont Tent	●	●	TBD	◕	TBD	◑	●	●	●	●	◑	TBD	◑
48	Karcher Portable Lightweight Decontamination System DS 10	●	●	TBD	◑	○	◑	●	●	●	●	TBD	●	●
49	Karcher Hot Air Generator FB 60 E	●	●	TBD	◑	TBD	●	TBD	○	●	●	●	TBD	●
50	Karcher MPDS MultiPurpose Decontamination System	●	●	◑	◕	TBD	◑	TBD	○	●	●	TBD	TBD	TBD
51	Karcher Hot Air Generator FB 20	TBD	TBD	TBD	◕	TBD	◑	TBD	◑	●	●	TBD	●	◑
52	Karcher AEDA1 Decontamination Equipment	●	●	TBD	◑	TBD	◑	●	◑	●	●	TBD	●	◑
53	Karcher M600 Decontaminant Mixer	TBD	TBD	TBD	◑	TBD	NA	TBD	◕	●	●	TBD	●	◑
54	Atmospheric Pressure Plasma Jet	TBD	TBD	TBD	◑	TBD	◑	TBD	TBD	TBD	TBD	TBD	TBD	TBD

'TBD' (to be determined) - there are no data currently available to support that selection factor.
'NA' - the specific selection factor is not applicable for the piece of equipment.
See Table 7-6 for selection factor definitions.

Table 7-4. Equipment decontamination systems

September 2000

ID #	Equipment Name	Chemical Agents Decontaminated	Biological Agents Decontaminated	TIMs Decontaminated	Functional Applications	Capacity/Throughput	Effectiveness of Decontamination	Set-Up Time	Power Capabilities	Operational Conditions	Durability	Resources	Operator Skill Level	Training Requirements
55	Decon Hoop	●	●	TBD	◕	TBD	◑	◑	●	TBD	●	TBD	●	●
56	SNL Decon Formulation	●	●	TBD	●	NA	◕	●	●	●	●	●	●	●
57	Reactive Skin Decontaminant Lotion (RSDL)	●	◕	TBD	◕	NA	◕	●	●	◑	◑	●	●	●
65	Decontamination Apparatus, Portable, DS2, ABC-M11	○	○	TBD	◑	○	◑	TBD	TBD	●	TBD	TBD	●	●
66	M13 Portable Decontaminating Apparatus (DAP)	●	●	TBD	◑	○	●	TBD	●	●	TBD	TBD	●	●
67	NBC6F Water Purification Unit (WPU)	TBD	TBD	TBD	◕	○	◕	TBD	TBD	TBD	TBD	TBD	TBD	TBD

'TBD' (to be determined) - there are no data currently available to support that selection factor.
'NA' - the specific selection factor is not applicable for the piece of equipment.
See Table 7-6 for selection factor definitions.

Table 7-5. Infrastructure decontamination equipment

September 2000

ID #	Equipment Name	Chemical Agents Decontaminated	Biological Agents Decontaminated	TIMs Decontaminated	Functional Applications	Capacity/Throughput	Effectiveness of Decontamination	Set-Up Time	Power Capabilities	Operational Conditions	Durability	Resources	Operator Skill Level	Training Requirements
26	Blast Guard	●	●	TBD	◕	TBD	●	●	◕	◑	●	○	○	○
27	First Responder's Blast Guard	●	●	TBD	◕	TBD	●	●	●	◑	●	◑	○	○
33	Karcher Decojet-Trailer Decontamination System	●	●	TBD	●	◑	◑	TBD	TBD	●	●	TBD	○	○
40	Karcher DECOCONTAIN 3000 Decontamination System	●	●	◑	●	◕	●	TBD	◕	●	●	◑	○	○
44	Karcher DECOCONTAIN 1500 Decontamination System	●	●	TBD	●	◕	●	TBD	TBD	●	TBD	TBD	○	○
46	Karcher C8-DADS Direct Application Decontamination System	●	●	◑	◕	TBD	●	TBD	○	●	●	TBD	●	◑
56	SNL Decon Formulation	●	●	TBD	●	NA	◕	●	●	●	●	●	●	●
67	NBC6F Water Purification Unit (WPU)	TBD	TBD	TBD	◕	○	◕	TBD	TBD	TBD	TBD	TBD	TBD	TBD
72	Zenon Advanced Double Pass Reverse Osmosis Water Purification Unit	TBD	TBD	TBD	◑	●	◑	TBD	○	◕	TBD	TBD	TBD	TBD

'TBD' (to be determined) - there are no data currently available to support that selection factor.
'NA' - the specific selection factor is not applicable for the piece of equipment.
See Table 7-6 for selection factor definitions.

Table 7-6. Selection factor key for decontamination equipment

September 2000

	Chemical Agents Decontaminated	Biological Agents Decontaminated	TIMs Decontaminated	Functional Applications	Capacity/ Throughput	Effectiveness of Decontamination	Set-Up Time	Power Capabilities	Operational Conditions	Durability	Resources	Operator Skill Level	Training Requirements
●	Decontaminates all nerve and blister agents	Decontaminates all biological agents	Decontaminates all of the TIMs listed	Decontaminates all application areas	More than 500 personnel; 20 large or 100 small pieces of equipment; or 10000 sq ft of area	Capable of neutralization and physical removal of contaminants	Less than 30 min	No power required	Operates in all expected environments	Capable of operating in harsh environments	One individual is required to use the decontamination system	No special skills or training required	No special training required
◕		Decontaminates multiple biological agents		Decontaminates multiple application areas	From 100 to 500 personnel; 10 to 20 large or 50 to100 small pieces of equipment; or 5000 to 10000 square feet of area	Capable of neutralization but not physical removal of contaminants	From 30 min to 60 min	Vehicle or AC powered	Operates in most environments				
◑	Decontaminates either the nerve or blister agent class	Decontaminates only one biological agent	Decontaminates multiple TIMs	Decontaminates at least one of the application areas	From 50 to 100 personnel; 5 to 10 large or 25 to 50 small pieces of equipment; or 2500 to 5000 sq ft of area	Capable of physical removal but not neutralization of contaminants	From 60 min to 120 min	AC powered	Operation is restricted to certain environments	Operation is restricted to certain environments	Two people are required to use the decontamination system	No special skills but training required	Less than 8 h training required
◔			Decontaminates only one TIM										
○	Decontaminates none of the nerve or blister agents	Decontaminates no biological agents	Decontaminates none of the TIMs listed	Decontaminates none of the application areas	Less than 50 personnel; 5 large or 25 small pieces of equipment; or 2500 sq ft of area	Not capable of physical removal or neutralization of contaminants	Greater than 120 min	Other power sources such as diesel engines, electrical generators, etc	Operates only at room temperature	Not capable of operating in harsh environments	More than two people are required to use the decontamination system	Technician required to operate equipment	More than 8 h training required

The blank cells designate that the symbol is not applicable for the selection factor.