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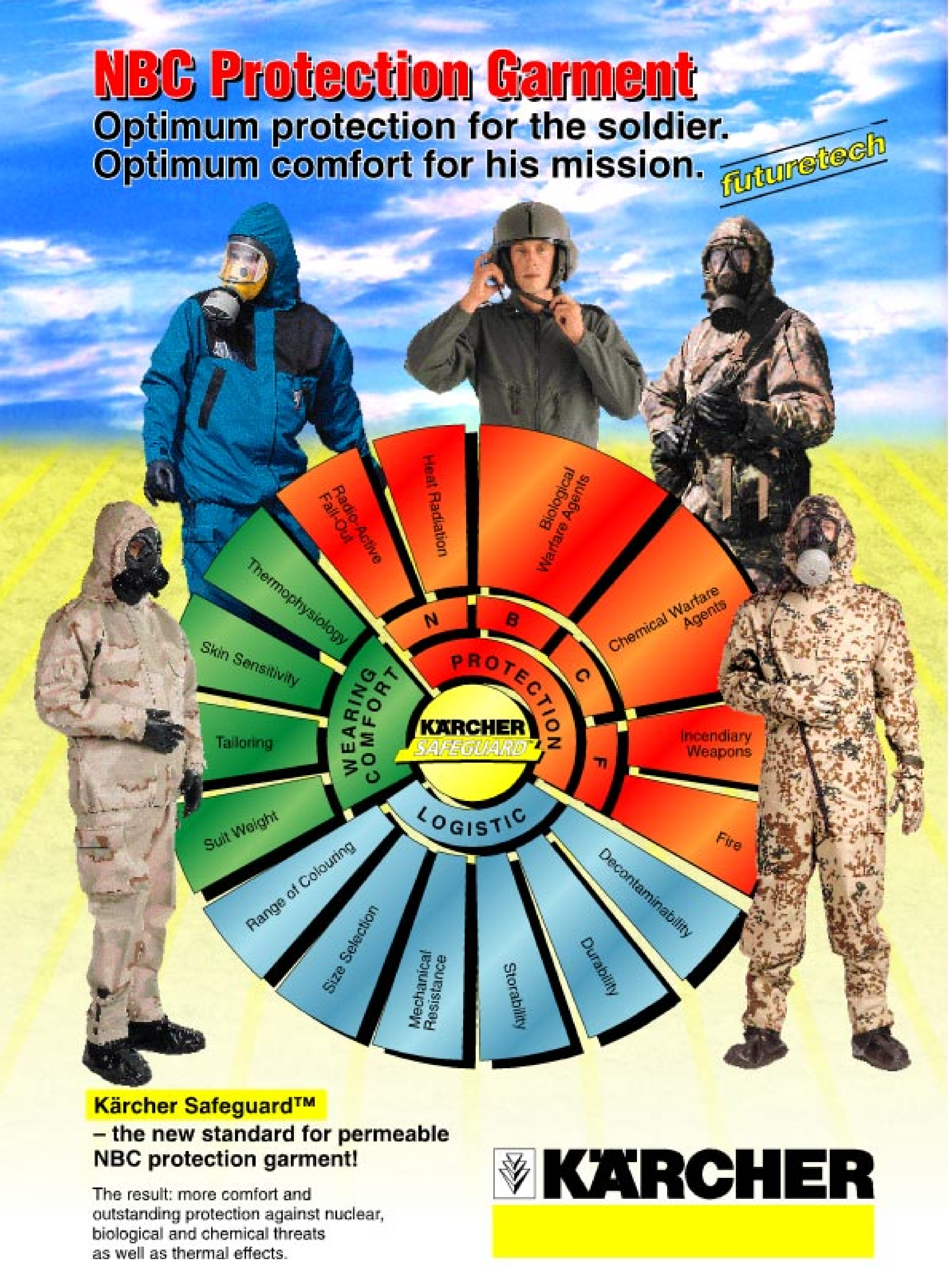
Pocket Handbook

# Nuclear Biological Chemical Defence

Hans-Joachim Töpfer




# Pocket Handbook

# Nuclear Biological Chemical (NBC) Defence

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March 2000 Edition

2nd revised Edition

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**Editor:**

**Alfred Kärcher GmbH & Co.**
**D-71364 Winnenden/Germany**
Product Range Special Customers

**Töpfer, H.-J.; Pocket Handbook Nuclear Biological Chemical (NBC) Defence**
**Winnenden 2000**



This pocket handbook can be ordered from:

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Product Range Special Customers
Alfred-Kärcher-Straße 28 - 40
D-71364 Winnenden/Germany

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Nominal charge: DM 18,00

**Contents**



The concise information in this handbook shall offer its readers hints and recommendations for the protection of their health and life under the conditions of a possible NBC attack.

The pocket size of this handbook, does, of course, not allow a detailed explanation of all relevant aspects or connections and does, thus, not replace the respective specialist literature.

## 1 Threat by NBC weapons and consequences for the NBC defence

To say in a time of worldwide political and military detension that a real threat caused by NBC weapons (or weapons of mass destruction) still exists, which consequently requires the necessary measures in the civilian and military sectors, will probably be rejected by many circles.

Inspite of the existing international conventions, for example the 1972 Biological Weapons Convention (BWC) and the 1997 Chemical Weapons Convention (CWC), it must be emphasized that the theoretical and practical basis for production, storage and employment of these weapons still exists, and that the fall of the former Warsow Pact and the political as well as military instability of some of the succession states have caused uncalculable or at least hardly calculable risks.

A look at the history of war shows in fact that NBC weapons have only been used selectively in former conflicts, but one phenomenon is clearly visible:

**NBC weapons were used every time when the enemy was not or unsufficiently prepared for defence operations against these weapons and due to this fact, a most successful use of these weapons could be predicted**

To render defence of a country credible, and build up a perfect defence system, it is necessary to judge all aspects of NBC defence in all armed forces as well as in civil defence, and to take the resulting consequences into consideration when establishing defence plans, and to carry them out in advance in times of peace as far as necessary.

To ensure a reliable NBC defence system, which is able to function under the complicated conditions and phenomena of modern wars, conscientious, complete and timely organisation and carrying out of the relevant NBC defence and protection measures are necessary.

In this context it must be emphasized that

**a partial realisation of NBC defence and protection measures does not guarantee sufficient protection of the troops, the civilian population, and the infrastructure against the effects of an attack with NBC weapons; the necessary effectivity of the NBC defence and protection measures is only achieved when these measures are realised completely and in time.**

An attack with NBC weapons gives a military conflict a new quality, another dimension, because for example
• the effect of fire can be increased by nuclear warheads so that many other operation-influencing factors become unimportant, and
• the use of chemical and biological warfare agents causes high personnel losses, the employment of defence material is hindered or becomes impossible, and infrastructure and buildings can no longer be used - or can hardly be used.

These effects caused by an attack with NBC weapons do not only have a far-reaching influence on the command of military operations, but in the same way (or even stronger) they also affect civil defence and thus the civilian population.

It must be clearly said that NBC weapons are applicable at any time, in any place (even over long distances) and in large quantities.

The fact that not only the troops, but also the civilian population is threatened by the effects of NBC weapons everywhere and anytime in the case of an attack, makes it absolutely necessary to include NBC defence measures in all defence-political reflections and preparations.

Apart from this it should be taken into account that in a war using NBC weapons, the morale and physical power of the people have an essential influence on the course of a battle and its successful outcome, since the effects of NBC weapons multiply the strain on the single soldier in an inconceivable way. Additionally, there are close interactions between the morale of the soldiers, preparation of the country for the protection of the civilian population, and readiness and ability of the people to bear the psychological and physical strain caused by a war with NBC weapons. In the case that the population is exposed to the effects of NBC weapons without sufficient or only unsatisfactory protection and is therefore not able to bear this strain under NBC conditions (since it is not equipped and prepared sufficiently), the morale of the soldiers will be destroyed in a flagrant way. Worry about relatives will undermine the readiness of the individual soldier to bear the psychological and physical strain of a war under NBC conditions.

The result of which is that, the existence of a suitable and complete system offering all sectors sufficient NBC protection in a war under NBC conditions, is required in a country's defence framework.

The necessary preparations regarding personnel, material, organisation, and training, must be made in peace time, and must be constantly checked and updated. To start these preparations at the beginning of a conflict, would have fatal effects on defence policy.

It is very important that reliable and functionable NBC protection of the civilian population is created in times of peace. It can be used to decrease the effects of a nuclear accident with global consequences (1986 Tschernobyl), the spread of biological disease-causing agents (1994 epidemic of pest, India) and release of highly-toxic/harmful substances in accidents (1984 Bhopal, India).

All these accidents hit the civilian population in a disproportionally strong way. Comparable accidents could happen world-wide at any time.

As NBC weapons do not only affect military personnel and institutions, but also the civilian sector, intensive cooperation between civil and military institutions in the field of NBC defence problems is indispensible. Whereas the NBC defence conception has to be coordinated between the civilian and military decision-makers at the highest governmental level in view of reciprocal adaptability, it is a task of the subordinated executive authorities and institutions to prepare the practical realisation of this conception on the basis of the respective decisions with regard to personnel and material required.

Cooperation means first and foremost mutual information about the NBC situation and exchange of findings in the framework of the NBC alarm and warning service.

Additionally, the military sector has to be prepared to practically support the civilian sector, especially concerning decontamination tasks in the case that means and possibilities of civil defence are not sufficient and the military situation allows this support. In the field of medical NBC protection close and continuous cooperation and mutual support will be absolutely necessary, because the use of NBC weapons will quickly increase the number of NBC and conventially injured persons, which can only be met by coordinated employment of all power and means available in a country.

The realisation of the aims of NBC defence, which are

**to ensure the survival of the individuum under the conditions of an attack with NBC weapons, to maintain ability to continue the objectives even under NBC conditions, and to maintain readiness for action even under long-term NBC conditions,**

requires

- NBC defence measures as a whole system including the different areas of application
- an NBC defence conception which is suited and adapted to the concrete needs of the country
- the realisation of this conception by means of timely selection, supply, and integration of NBC defence personnel and material into all command levels and sectors
- differentiated training of the whole personnel in how to act before, during and after attacks with NBC weapons as well as in the use of personal NBC protection equipment.

*The consequences of accidents in the chemical industry and nuclear power plants or affecting the infra-structure can have effects comparable to those resulting from an attack with NBC weapons.*

## 2 Nuclear weapons

### 2.1 Nuclear weapons and their destructive effects

Nuclear weapons are weapons of mass destruction whose destroying effect is based on the release of energy resulting from the chain reaction during the fission of heavy nuclei of some isotopes of uranium and plutonium or during the thermonuclear synthesis reactions of light nuclei of the isotopes of hydrogen (deuterium, tritium).

Therefore nuclear weapons fall into two main categories, nuclear fission and nuclear fusion weapons. Nuclear fission weapons depend on the splitting of heavy elements such as uranium or plutonium for their power. Nuclear fusion weapons depend on the fusing together of separate atoms of a light element such as hydrogen.

The potential destructive power of such weapons is stated in the equivalent power of the conventional high explosive TNT (kt - kilotons; Mt - megatons). The power of the Hiroshima bomb was approximately 20 kt. A typical nuclear fusion bomb could have a power of 10 Mt.

Nuclear bursts differ in ground bursts (detonation under or close to the ground or sea level) and air bursts (detonation in the air; the fireball does not touch the earth´s surface). The Ground Zero (GZ) is the point below the centre of the nuclear burst.

Nuclear weapons harm the human organism depending on the detonation strength, type of detonation, distance from the detonation centre, geographical conditions (relief of the terrain, buildings, meteorological conditions, protection degree and behaviour in the case of detonations of nuclear weapons, by the following defeat factors: light and heat radiation, blast wave, nuclear radiation, and nuclear electromagnetic pulse (NEMP) and their combinations.

The detonation (burst) of a nuclear weapon releases massive amounts of energy within an extremely short period of time. The immediate result is an extremely rapid rise in temperature (to tens of millions °C). The immediate physical effect of the heat release is a fireball around the point of detonation. Due to the temperature involved the fireball is not static and expands outwards and starts to rise immediately as it is formed. Even in daylight the degree of light produced by a nuclear detonation is far brighter than the sun at noon. The light can be so intensive that it causes temporary or permanent blindness. At night these effects are magnified considerably. The heat radiation can produce immediate conflagrations of inflammable materials. The effects on the human body can vary from immediate death by burning to reddening of the skin.

The heat and light radiation are followed by a blast wave. The expanding air around the fireball moves outwards at high speed and thus creates a blast wave (shock wave). Any point passed by the blast wave will experience a very rapid and intensive rise in pressure. This pressure (overpressure) can be so intensive that even robust structures can be knocked down or damaged. As the blast wave passes a point it will then experience a period of relatively low pressure (partial vacuum) in the wake of the blast wave. This secondary blast wave completes the destructive effects of the main blast wave.

Nuclear radiation can occur as immediate or residual radiation. Immediate radiation is produced at the actual instant of the nuclear detonation, mainly in the form of gamma rays and neutrons. The immediate radiation (lasting up to one minute after detonation) can be extremely harmful to life. It has the effect of irradiating all material in its vicinity. The radiation produces numerous radioactive isotopes (neutron-induced radioactivity) that in their turn produce radiation. The radioactive particles accumulated by the fireball will be transported far and wide by the wind and will fall back to the earth in the form of "fallout" (also as "rainout" or "washout"). The residual radiation from a nuclear groundburst can deliver a much more harmful fallout in comparison with the residual radiation coming from an airburst.

The strength of radioactivity, its extent and duration will depend upon many factors, from the size of the nuclear device to the altitude at which the bomb was detonated. Residual radiation from a high-altitude airburst could be negligible in human risk terms while a groundburst could result in massive amounts of potentially harmful fallout. The effects of nuclear radiation on life can vary from the minute to the drastic. All radiation, in whatever form it is produced, can have some effect on life but in excess it produces all manner of physiological disturbances from preventing mytosis (cell division) to the creation of dangerous cancers. If large amounts of nuclear radiation are received within a short time, death can result after only a short period. Equally, large radiation doses absorbed over a long period may have few discernible effects although adverse effects may appear in the long term.

The nuclear elctromagnetic pulse (NEMP) is another result of the huge energy release produced at the instant of a nuclear detonation, especially where airbursts are involved. The effect of altering the electrical properties of the electrons in the nearby atmosphere produces intensive electrical and magnetic fields. These fields can establish eddy currents of considerable strength which by themselves may have significant of effects on electronic-based equipment. The effects of NEMP can travel further than those of the other destructive hazards.

## 2.2 Possible protection measures against the effects of nuclear weapons

The degree of protection of the human against the destructive effects of nuclear weapons mainly depends on the level of preparation (availability of protective shelters, rescue vehicles and equipment, medicine, etc.), the speed of response and the individual's knowledge of nuclear protection. It is possible to protect against all destructive effects. The time in which a harmful effect of the blast wave must be taken into consideration, lasts a few seconds to some tens of seconds between the light flash of a nuclear weapon detonation and the arrival of the blast wave. Independent of this, light and heat radiation and immediate radiation are effective immediately. Even a modest covering of earth or hard cover provided by structures can provide some measure of protection against the heat and blast effects of nuclear bursts. The same protective measures can also be used against immediate and residual nuclear radiation.

### 2.2.1 Possible protection measures against light and heat radiation

Light radiation for example can, in general, only directly affect unprotected persons at the moment of detonation. Due to the straight distribution of light radiation, shade providing objects offer relatively good and reliable protection. However, the immediate effect of light radiation makes taking cover in time quite impossible. However, taking cover can reduce the destroying effect of light radiation (especially the degree of possible burns to the skin).

➥ **Established preventive fire protection**

- Use of non-inflammable materials
- Impregnation of inflammable components
- Removal of easily inflammable materials close to endangered plants
- Presence of fire extinguishers and organisation of fire-fighting in time, etc.

➥ **Immediate taking of cover in the case of a nuclear weapon detonation**

> *Attention:*
>
> *Every shade-providing object shields from light radiation and thus offers protection!*

➥ **Protection against blinding**

- Close the eyes immediately at the moment of the light flash
- Do not look in the direction of the detonation
- Face to the ground when taking cover

> *Attention:*
>
> If correct action is taken the blinding effect caused by the light radiation is only temporary.

➥ **Extinguishing or removing burning clothing**

- Try to beat out the flames or to smother them by rolling on the ground
- Remove burning clothing
- Immediate self and comrade aid

### 2.2.2 Possible protection measures against a blast wave

Due to the smaller target, a lying person is harmed considerably less by the blast wave and flying rubbles, splinters of glass, etc. than one who is standing.

➥ **Stay in protective buildings**

- Cellars
- Bunkers, etc.

➥ **Take cover – throw yourself down, press your body onto the ground**

- behind low walls, tree stumps, in ditches, hollows, etc.
- in trenches, bomb craters, etc.

➥ **Leave cover only after the blast wave has passed the area**

### 2.2.3 Possible protection measures against immediate radiation

Due to the respective interactions, radiation is weakened when passing through materials.

> *Attention:*
>
> *Therefore, make use of the weakening effect of cover!*

➥ **Stay in protective buildings**

- Cellars
- Bunkers, etc.

➥ **Take cover immediately in the case of a nuclear weapon detonation**

- behind low walls, tree stumps, etc.
- in trenches, bomb craters, etc.

### 2.2.4 Possible protection measures against residual radiation

In contrast to immediate radiation, the effect of residual radiation lasts for a longer period of time (hours, days, weeks). The radiant intensity decreases over the course of time.

➥ **Stay in protective buildings**

- Close windows and hatches
- Switch on the NBC protective ventilation system

➥ **Reduce or minimise the time spent on radio-actively contaminated terrain to the absolute minimum**

➥ **Avoid the inhalation of radio-active dust and direct contact to contaminated material**

- Put on individual NBC protection equipment

➥ **Measure and evaluate the nuclear radiation**

- Measure and evaluate the radiation the personnel is exposed to (dosimetry)
- Measure and evaluate the the contamination degree of material (radiometry)

➥ **Carry out decontamination measures**

### 2.2.5 Possible protection measures against the nuclear electromagnetic pulse (NEMP)

The essential requirements for the protection against the destructive effect of the NEMP should already have been considered and carried out when constructing and producing the respective devices, systems and plants. For protection reasons, persons should avoid contact with metal parts during a nuclear detonation.

> ***Attention:***
>
> ***Do not eat, drink or smoke on contaminated terrain!***

## 3 Biological weapons

### 3.1 Description of biological weapons

Biological Warfare (BW) involves the use of living organisms, or the products of living organisms(toxins) as weapons. Classical biological warfare agents include bacteria, viruses, rickettsia, fungi, protozoa, and toxins from organic matter to damage or kill humans, animals or plants. In particular, toxins have been categorised as both biological and chemical weapons, and therefore toxins are banned by both the 1972 BW and the 1997 CW Convention.

Biological weapons are fundamentally different to nuclear and chemical weapons for the following reasons:

- ability of the microorganisms to reproduce within the host after transfer and dissemination thereby causing infection;
- at present, there are no BWA detectors with anything like the capabilities of the vast array of CWA detectors now in service (it is virtually impossible to detect biological warfare agents until it is too late);
- distribution of even small quantities of bacteria or toxins in suitable wind currents could result in vast areas being contaminated many kilometres from the point of release;
- high virulence and absence of a widespread immunity, etc.
- the use of biological weapons can cause mass panic;
- biological weapons can be produced quiete easily and at low cost;
- dissemination in many ways (dispensing of agents in aerosol form from aircraft; spreading of spores such as anthrax from aircraft bombs; vectors such as insects could be spread far and wide by simply releasing them, either on the ground or from an aircraft, etc.;
- one of the military 'attractions' of the biological weapon is its surprise use;
- delay factor (bacteria and toxins take time to produce their unpleasant end effects, with time delays varying from hours to days);
- potential weapon for terrorists.

The table (page 9) is an incomplete outline of the biological agents known to have been considered for use in war. New genetically developed disease agents, or virulent variations of otherwise relatively harmless existing ailments, could be introduced at almost any time.

### 3.2 Possible protection measures against the effects of biological weapons

Protection against biological weapons is extremely complicated as it can not be immediately ascertained whether and where they have been employed. Besides vaccination, etc. cleanliness, personal hygiene and controlled intake of foodstuff and drinking water are the essential prophylactic protection measures.

The most probable biological warfare agents will in part be chosen for their ability to cause diseases which are difficult to treat using conventional medical techniques. Once an individual has been infected, the use of drugs, disinfection and sterilisation are not likely to be sufficient to combat the threat from biological warfare agents. Fortunately there is the possibility of providing an additional and highly effective medical countermeasure in the form of vaccination of personnel. It could be well considered that the vaccination of a whole population might be necessary should there be any indication that a biological warfare attack against them is a possibility. Vaccination programmes are nothing new and are familiar to most modern societies, but they have to be carried out in a planned and controlled manner. A rushed programme just prior to an outbreak of hostilities will rarely provide the required complete protection levels, and could produce unwanted side-effects, while many vaccination programmes involve repeated treatments carried out over a period of time. It can thus be seen that vaccination against biological warfare agents involves an involved logistic and medical programme. However, these potential difficulties are minor compared to the problems that could arise should no vaccination programme be conducted at all.

The following overview is an uncomplete compilation of the most important effects and countermeasures of biological warfare agents.

*Attention:*

*Cleanliness, personal hygiene and controlled intake of food and drinking water are the most important preventive measures.*

| Disease | Symptoms | Incubation period |
|---|---|---|
| **Bacteria** | | |
| **Anthrax** | Cutaneous form: sores or blisters form on hands or forearms<br>Pulmonary form: non-specific chest cold symptoms followed by respiratory distress, fever, shock, or death<br>Intestinal form: intense stomach pain, bowel obstruction, dehydration, diarrhoea, fever, blood poisoning, death | 2 to 7 days (most cases within 48 hrs)<br>infective dose:<br>8.000 to 50.000 spores |
| **Tularemia** | Sudden onset of chills, fever, headache, muscle aches, fatigue, loss of body fluids; typhoid-like symptoms; deep ulcers found on skin with swelling of lymph nodes | 2 to 10 days<br>infective dose:<br>10-50 organisms |
| **Plague** ("Black Death") | High fever, headache, general aches, extreme weakness, glandular swelling, pneumonia, haemorrhages in skin and mucous membranes possible, extreme lymph node pain | Bubonic: 2 to 6 days<br>Pneumonic: 1 to 6 days<br>infective dose:<br>100-500 organisms |
| **Cholera** | Acute infectious gastrointestinal disease, vomiting, diarrhoea, rapid loss of fluids, severe muscular cramps, collapse | Hours to 5 days |
| **Diphtheria** | Mild sore throat, slight fever, possible stoppage of air passages | 2 to 5 days or longer |
| **Rickettsia** | | |
| **Q Fever** | Sudden onset of fever, headache, chills, weakness, profuse perspiration; respiratory problems, mild coughing; chest, muscle, joint pain | 2 to 3 weeks<br>infective dose: 1-10 org. |
| **Rocky Mountain Spotted Fever** | Fever, chills, headache pain in joints and muscles, skin rash spreads rapidly on third and fourth day from ankle and wrist to legs, arms, and chest; neurological abnormalities | 3 to 14 days |
| **Typhus** | Headache, high fever, general aches and pains, chills, rash | 6 to 14 days |
| **Viruses** | | |
| **Encephalitis** | Fever, headache, dizziness, drowsiness or stupor, tremors or convulsions, severe prostration, occasional paralysis | 2 to 15 days |
| **Dengue Fever** | Grades of severity, haemorraghic fever, intense headache, backache, excruciating joint and muscular pain, weakness, prostration, irregular rash, loss of appetite and constipation, abdominal discomfort with colicky pains and tenderness, spontaneous bleeding into the skin, gums, and gastrointestinal tract, circulatory failure, profound shock with no blood pressure | 3 to 15 days |
| **Yellow Fever** | Range from very mild to malignant, sudden onset of chills, fever, prostration, headache, backache, muscular pain, congestion of mucous membranes, nausea, vomiting, jaundice from liver damage, bleeding from stomach and gums, black vomitus | 3 to 6 days |
| **Rift Valley Fever** | Headache, general aches and pains, nausea, vomiting, photophobia | 3 to 12 days |
| **Influenza** ("la grippe") | Catarrhal inflammation of the respiratory tract; sudden onset; fever of 1 to 7 days duration; marked prostration; and generalised aches and pains in back, limbs and muscles; sore throat, bronchitis and pneumonia are complications of secondary bacterial infections. Soiled articles and discharges from the mouth and nose of infected persons are the main sources of infection. | Type A: 1 to 2 days<br>Type B: 12 to 18 hours<br>epidemic disease, occasionally pandemic |
| **Toxins** | | |
| **Botulinum Toxin** | Botulism is a highly fatal, acute poisoning, it is characterised by vomiting, constipation, thirst, general weakness, headache, fever, dizziness, double vision, dilation of the pupils, paralysis of the muscles involved in swallowing and difficulty of speech. Respiratory paralysis is the usual cause of death. | 12 to 72 hours |

**Anthrax**
The mortality rate of untreated cutaneous anthrax can be up to 25 %; in pulmonary cases 100 %. Cutaneous anthrax can be treated effectively with some antibiotics (penicillin, aureomycin, terramycin, chloromycetin); sulfadiazine and immune serum. The disease is not epidemic in man. The spores are very stable and may remain alive for many years in soil and water. They will resist sunlight for several days. Steam under pressure or exposure to dry heat above 159 °C for one hour are necessary to kill the spores. Effective decontamination also can be accomplished by boiling contaminated articles in water for 30 minutes or by using some of the common disinfectants. Iodine and chlorine are most effective in destroying spores and vegetative cells.

**Tularemia**
All ages are susceptible, and recovery from an attack is followed by permanent immunity. The infection rate ranges from 90 to 100 %. Untreated cases have a death rate of 4 to 8 %. Vaccination greatly reduces the severity of the disease and may prevent infection in some cases. Antibiotics (streptomycin, aureomycin, chloromycetin) are effective. The disease is essentially sporadic, but may be epidemic when modes of transmission are prevalent. It is not transmitted directly from man to man. The organism remains viable for weeks in water, soil, carcases and hides, and for years in frozen rabbit meat. It is resistant for months to temperatures of freezing and below. It is rather easily killed by heating at 38 °C or above for 2 to 3 minutes and by 0.5 % phenol in 15 minutes.

**Plague**
Untreated Bubonic Plague has a mortality rate of 30 to 60 %, untreated Pneumonic Plague kills from 90 to 100 % of its victims. Anti-Plague serum produces an artificial passive immunity of two weeks' duration. Active immunisation with killed bacterial vaccines is protective for some months when administered in two or three doses at weekly intervals, repeated stimulating doses being necessary. Prompt treatment with sulfonamides and streptomycin (chloromycetin and aureomycin may be used if resistance to streptomycin develops) combined with serum therapy is essential and is effective if used early. Strict area quarantine and sanitation, in addition to other measures such as rat flea extermination. The organism will probably remain viable in water from 2 to 30 days and in moist meal and grain for about two weeks. At near freezing temperatures, it will remain alive from months to years but is killed by 15 minutes exposure to 72 °C. It also remains viable for some time in dry sputum, flea faeces and buried bodies but is killed by three to five hours exposure to sunlight. Decontamination is effected by boiling, use of dry heat above 72 °C or steam, and treatment with lysol or chloride of lime.

**Cholera**
The mortality rate ranges from about 3 to 30 % in treated cases to 50 % in untreated cases. Artificial immunisation with vaccines is of variable degree and uncertain duration (6 to 12 months). Acquired immunity lasts for many years. The first consideration in the treatment of cholera is to replenish the fluid and mineral losses of the body. Drug therapy has little or no effect upon the clinical course of the disease. However, chloromycetin, aureomycin and terramycin, given by mouth, cause rapid disappearance of the vibrio organisms, thus reducing the spread of the disease. Epidemicity is very high under insanitary conditions, especially those involving water supplies, foods and fly control. The organism is easily killed by drying. It is not viable in pure water, but will survive up to 24 hours in sewage, and as long as six weeks in certain types of relatively impure water containing salts and organic matter. It can withstand freezing for three to four days. It is readily killed by dry heat at 117 °C, by steam and boiling, by short exposure to ordinary disinfectants and by chlorination of water.

**Diphtheria**
The disease is endemic and epidemic around the world. The fatality rate is variable, depending upon the virulence of the infecting strain; among untreated cases it may range from 10 to 50 %. In cases receiving anti-toxin treatment, this rate is lowered to 2 to 8 %. Diphtheria toxoid is extremely effective. Permanent immunity may be maintained by means of booster inoculations at regular intervals. Diphtheria anti-toxin is effective when given promptly and in adequate dosage. Penicillin as a supplementary treatment suppresses secondary invaders, shortens the period of illness and reduces the number of convalescent carriers. Epidemicity is high, depending on the immunity status of the population and degree of exposure to the disease. The diphtheria organism is more resistant to light, drying and freezing than most non-sporulating bacilli, remaining viable for a long time in air and dust. It is capable of surviving many hours on a cotton swab and has been cultured from dried bits of diphtheritic pseudo-membrane after 14 weeks. It is destroyed by ordinary antiseptics and by being boiled for 12 minutes or being heated to 75 °C for 10 minutes.

**Q Fever**
Fatalities are rare, but may be up to 4 % during epidemics. Vaccines have been effective when used by laboratory personnel, slaughterhouse and stockyard workers. Appropriate antibiotics (aureomycin, chloromycetin, and terramycin) may be effective. Supportive treatment is indicated. The disease is relatively non-contagious. The micro-organism is resistant to 0.5 % phenol, and is relatively resistant to desiccation. It is killed by 0.5 % formalin. It probably persists on surfaces from 5 to 60 days.

**Rocky Mountain Spotted Fever**
Fatality rates range from 7 to 20 %. Appropriate antibiotics (chlorotetracycline, chloramphenicol, oxytetracycline) are effective in reducing the mortality and in shortening the course of the disease. Supportive treatment is also indicated. The micro-organism can be destroyed by heating at 44 °C for 10 minutes and by drying for 10 hours, and inactivated by use of 0,1 % formalin and 0,5 % phenol.

**Typhus**
The course of epidemic typhus can be shortened by the use of antibiotics (tetracyclines, chloramphenicol). Supportative treatment and prevention of the secondary infections are essential. Vaccines confer considerable protection of uncertain duration. Immunisation should be repeated every 4 months. The micro-organism can be destroyed by heating at 44 °C for 15 to 30 minutes, and inactivated by use of 0,1 % formalin and 0,5 % phenol.

**Encephalitis**
Susceptibility ranges from 90 to 100 %. Recovery from an infection results in an excellent short-term immunity to the specific virus, but not to any other type. The mortality rate is unknown; it is probably 5 to 60 % with all types. Some effective virus vaccines have been developed on a small scale, but their widespread use is not practicable at present. Treatment is supportive only; chemotherapy and antibiotic treatments have not been developed. Transmission from man to man is not known to occur but may be possible by means of respiratory droplet infection. Stability varies among the different types (some viruses are inactivated at 74 °C in 30 minutes; other viruses withstand this treatment and also resist 1 or 2 % phenol).

**Dengue Fever**
The fatality rate is very low. A mouse-adapted virus vaccine has been found to be stable, safe and effective in studies on human volunteers and will probably be useful in control of epidemics. There is no specific therapy, but supportive treatment is essential. The virus does not spread directly from person to person. Epidemics occur in areas where vector mosquitos are present in large numbers. The infection rate is extraordinarily high, with 75 to 100 % of the inhabitants of a locality being attacked. Any spread of the disease can be prevented by diligent mosquito control. Blood from a patient remains infectious after storage in a refrigerator for several weeks. The virus may be preserved in a frozen and dried state at 23 °C for at least five years. The virus is deactivated by ultraviolet light and by 0.5 % formalin.

**Yellow Fever**
The fatality rate is probably about 5 %. Inoculation with a modified living virus vaccine confers an active immunity which may last for at least four years and probably longer. There is no specific treatment. Supportive treatment (bed rest and fluids) is essential for even the mildest cases. The virus is resistant to freezing and drying but is destroyed by being heated at 78 °C or above for 10 minutes. It is rather easily inactivated by common antiseptics. Mosquito control measures, including use of insecticides, are the preferred methods of control.

**Rift Valley Fever**
Mortality is 90 to 95 % in lambs, 35 to 45 % in adult sheep and 5 to 20 % in cattle. A living virus vaccine is in use in South Africa. Treatment is supportive only. Epidemicity is dependent on the presence of diseased animals and the specific mosquito vector. The virus is said to be destroyed by exposure to a temperature of 73 °C for 40 minutes.

**Influenza**
The virus is highly infectious and contagious; susceptibility is general, there being relatively little natural resistance. The resistance of some individuals exposed to the disease during epidemics appears to be due to previous infection. Acquired immunity following recovery from an attack lasts only for a few months to a year, and is effective only against specific strains of the virus. Artificial immunisation methods produce a specific immunity of short duration. Epidemics may affect up to 50 % of a given population within 4 to 6 weeks. The disease has a mortality rate up to 1 %, but it is often followed by complicating respiratory infections which can result in high mortality. Vaccination with specific strains of the virus leads to an effective immunity of several months' duration against the same or closely related strains. The extreme antigenic variability of the influenza viruses makes it difficult to protect against all strains. Treatment is supportive only, with control of secondary infections. There is no specific effective treatment. The virus is killed by being heated at 73 °C for 20 to 30 minutes; it is resistant to freezing for several weeks. It can also be easily destroyed by steam, boiling and ordinary antiseptics.

**Botulinum Toxin**
Mortality is directly related to the amount of toxin consumed. Passive immunisation with anti-toxin appears to be encouraging as a protective measure for humans but is of little therapeutic value. Active immunisation with botulinum toxoid is of proved protective value. Treatment is mainly supportive. Anti-toxin therapy is of doubtful value, particularly where large doses of the poison have been consumed. The disease is not contagious. Epidemics occur only where widespread distribution and consumption of a contaminated food product have occurred. The toxin is stable for about one week in non-moving water where it is not aerated. It persists for a long time in food when it is not exposed to air. The toxin is destroyed when boiled for 15 minutes, but botulinum spores resist boiling for six hours. Pressure cooking will destroy the spores. Botulinum toxin differs from other bacterial toxins in that it is not destroyed by gastro-intestinal secretions.

*Attention:*

*Biological warfare agents*
*are potential weapons terrorists may employ.*

## 4 Chemical weapons

### 4.1 Descriptions of chemical weapons

Chemical weapons comprise of the chemical warfare agent and the means to deliver it to the target.

Chemical warfare agents (CWA) are chemical substances which are intended for use in warfare to kill, seriously injure, or incapacitate people through their physiological effects. A CW agent attacks the organs of the human body in such a way that it prevents those organs from functioning normally. The intention is either to prevent the human body from functioning at all or to somehow prevent some aspect or another of its processes from proceeding normally. The results are usually disabling to a varying degree, or fatal.

| Chemical Warfare Agent / Parameter | Choking Agent | Blood Agents | | Blister Agents | | Nerve Agents | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **CG** Phosgene | **AC** Hydrogen Cyanide | **CK** Cyanogen Chloride | **HD** Sulfur Mustard | **L** Lewisite | **GA** Tabun | **GB** Sarin | **GD** Soman | **VX** |
| **Molecular weight** | 99 | 27 | 61 | 159 | 207 | 162 | 140 | 182 | 267 |
| **Freezing point Fp** [°C] | - 118 | - 15 | - 6,5 | 14,5 | - 18 | - 49 | - 57 | - 42 | - 39 |
| **Boiling point Kp** [°C] | 8,2 | 26 | 15,5 | 217 | 190 | 240 | 151 | 198 | 298 |
| **Vapour pressure** $p_{s\,(20\,°C)}$ [mbar] | 1.565 | 816 | 1.002 | 0,092 | 0,525 | 0,084 | 1,97 | 0,35 | $1{,}4 \times 10^{-4}$ |
| **Volatility** $c_{s\,(20\,°C)}$ [$mg\ m^{-3}$] | $6{,}37 \times 10^{6}$ | $0{,}89 \times 10^{6}$ | $2{,}6 \times 10^{6}$ | 625 | 4.500 | 560 | $2{,}25 \times 10^{4}$ | 2.060 | 1,6 |
| **Vapour density** [air = 1] | 3,5 | 0,95 | 2,1 | 5,4 | 7,2 | 5,6 | 4,86 | 6,35 | 9,25 |
| **Liquid density** [$g\ cm^{-3}$] | 1,42 | 0,69 | 1,22 | 1,27 | 1,89 | 1,07 | 1,09 | 1,01 | 1,026 |
| **Persistency** Sunny, 15 °C | few minutes | few minutes | few minutes | 2 to 7 days | 3 to 6 hrs | 1 to 4 days | 15 min to 4 hrs | 2,5 to 5 days | 3 days to 3 weeks |
| Windy and rainy, 10 °C | few minutes | few minutes | few minutes | 12 hrs to 2 days | 12 hrs to 1 day | 30 min to 6 hrs | 15 min to 1 hrs | 3 hrs to 1,5 days | 1 to 12 hrs |
| Calm, sunny, snow, -10 °C | 15 min to 1 hour | 1 to 4 hrs | 15 min to 1 hour | 2 to 8 weeks | 2 days to 1 week | 1 day to 2 weeks | 1 to 2 days | 1 to 6 weeks | 1 to 16 weeks |
| **Toxicity** Main effect | death | death | death | death | death | death | death | death | death |
| Lethal dose **$LD_{50}$** [$mg\ kg^{-1}$] | - | 1 | - | 0,7 | 0,4 | 0,6 | 0,05 | 0,14 | 0,008 |
| Lethal concentration **$LCt_{50}$** [$mg\ min\ m^{-3}$] | $3{,}2 \times 10^{3}$ | $4{,}5 \times 10^{3}$ | $11 \times 10^{3}$ | $1{,}5 \times 10^{3}$ | $1{,}5 \times 10^{3}$ | 300 | 100 - 200 | 40 - 70 | 35 - 45 |
| Incapacitating concentration **$ICt_{50}$** [$mg\ min\ m^{-3}$] | $1{,}6 \times 10^{3}$ | $2 \times 10^{3}$ | $7 \times 10^{3}$ | $1 \times 10^{3}$ | $0{,}3 \times 10^{3}$ | 100 | 75 | 25 | 5 |
| **Penetration into the skin** [min] | | | | 3 - 5 min | | | 10 - 15 min | 10 - 15 min | 5 - 7 min |
| **Odour** | new mown hay or gras or green corn | bitter almonds | irritating properties are so great that the odour can not be perceived | odourless (possibly like mustard or garlic) | pungent | faintly fruity; none when pure | almost no odour in pure state | fruity; camphor with impurities | odourless |
| **Colour** | colourless | colourless | colourless | colourless | colourless | colourless (yellow-brown) | colourless | colourless | colourless (yellow) |
| **Solubility in water** [%] | 0,9 | ∞ | 6,4 | 0,8 | 0,05 | 12 | ∞ | 1,5 | 1 - 4 |
| **Physiological effects** | Lungs become filled with liquid, death results from pulmonary oedema, lack of oxygen; 'choke' unprotected persons | Affect the body functions through action on the enzyme cytochrome-oxidase, thus preventing the normal transfer of oxygen from the blood to body tissue | | Affect the eyes and lungs and blister the skin; react with body tissues causing inflammation, blisters, and destruction of tissues<br>At the time of exposure:<br>**HD:** little or no pain | **L:** immediate pain on contact | Interfere with the normal operation of the autonomic and central nervous systems; inhibition of acetylcholinsterease enzymes and resultant accumulation of acetylcholine<br>Results: uncontrolled contraction of muscles<br>Symptoms: miosis; dimness of vision; excessive salivation and sweating, muscle twitching; difficulty in breathing<br>Death: may result from inability to control breathing muscles | | | |

Depending on its physical properties and the method of application, the chemical warfare agent may present itself as liquid, aerosol, or vapour. Most CWA's are powerful organic solvents and able to penetrate into many polymeric materials. These present a dangerous contact risk. Material contaminated in such a way is difficult to decontaminate. Chemical warfare agents can also be "thickened" to increase their persistency by adding thickeners (viscious materials). On the battlefield chemical warfare agents have a much more immediate effect than biological warfare agents. The table (see page 12/13) of chemical warfare agents contains the most important of the known chemical warfare agents,but it should not be taken as complete.

Chemical warfare agents may be delivered in many different ways from aircraft (spray tanks, containers, aerial bombs), from artillery (shells,rockets, grenades), by missiles or from air- or ground-based aerosol generators. CWA can be weaponised in unitary (contains the CWA itself) or binary form. Binary chemical weapons contain the relatively innocuous two agent precursors of nerve agents (GB, VX) held in separate compartments during handling and storage. The ingredients are automatically mixed only after the binary weapon has been released from its delivery system. Thus the nerve agent is formed only after a chemical shell has been fired or a chemical bomb has been dropped. Larger chemical munition can contain chemical submunitions (bomblets).

Choking agents injure unprotected persons especially through the respiratory tract (particularly the lungs). In extreme cases, membranes swell, lungs become filled with liquid, and death results from pulmonary oedema. Phosgene has no skin or eye toxicity and exerts its effect only on the lungs and results in damage to the capillaries. When a lethal dose of phosgene is received, the air sacs become so flooded that air is excluded and the victim dies of anoxia (oxygen deficiency). If the amount of phosgene is less than a lethal dose and proper care is provided, the watery fluid is reabsorbed, the air cell walls heal and the patient recovers. But, different respiratory problems may remain chronic for years. Most deaths occur within 24 hours. Duration of effectiveness is short, vapour may persist for some time in low places in calm or light winds and stable atmospheric conditions (inversion).

Blood agents are absorbed into the body primarily by breathing. They prevent the normal transfer of oxygen from the blood to body tissue. Hydrogen cyanide and cyanogen chloride are highly volatile and dissipate rapidly. Blood agents rapidly reduce the capability of NBC mask filters.

Blister (vesicant) agents are used for medical casualty effect. The use of ground may be restricted, movements slowed, and use of terrain, material or installation hampered. These agents affect the eyes and lungs and blister the skin. Sulfur mustard is insidious in action: there is little or no pain at the time of exposure. Lewisite causes immediate pain on contact. Sulfur mustard is persistent and presents a long-term hazard. It penetrates quickly into polymeric materials such as rubberised protection clothing and can cause a breakthrough.

Nerve agents are more lethal and act more quickly than the other kinds of chemical warfare agents. They are organophosphorous compounds that inhibit the action of an enzyme (acethylcholinesterase) and therefore continually stimulate the nervous system. Nerve agents act rapidly (within seconds of exposure) and maybe absorbed through the skin, the eyes or the resporatory tract. In sufficient concentration, the ultimate effect of nerve agents is paralysis of the respiratory musculature and subsequent death. The exposure of a lethal dose may cause death in the shortest period of time (several minutes). Symptoms: runny nose, tightness of chest, dimness of vision and pin-pointing of the eye pupils, difficulty in breathing, drooling and excessive sweating, nausea, vomiting, cramps, involuntary defaecation and urination, twitching, jerking and staggering, headache, confusion, drowsiness, coma and convulsion. These symptoms are followed by cessation of breathing and death. The number and severity of symptoms which appear are dependent on the quantity and rate of entry of the nerve agent which is introduced into the body.

## 4.2 Protection possibilities against chemical warfare agents

> *Attention:*
>
> *Effective individual NBC protection equipment protects you against all known chemical warfare agents!*

The most important pre-requisite for effective protection against chemical warfare agents is quick and correct putting on of all parts of the individual NBC protection equipment. As most of the chemical warfare agents are taken in through the breathing organs, eyes and unprotected skin, the following should be observed in all cases:

**In the case of a sudden attack with chemical weapons:**

- ➥ **Stop breathing immediately and close your eyes**
- ➥ **Then put on the NBC protective mask and check that it sits correctly**
- ➥ **Breathe out audibly to remove warfare agent vapours from inside the mask**

> *Maximum time to put the NBC protection mask on:*
>
> ***10 seconds***

If the first toxification symptoms (miosis) are visible after a short time, the auto-injector with antidote (atropine) must be applied immediately!

**Use of antidotes for nerve-agent poisoning** (example)

**(1) Pre-treatment** (use before a CWA attack)

Antidote: Pyridostigmine
Application: can be used before a CWA-attack to limit nerve-agent-related damage

**(2) Standard treatment**

Antidote: Atropine
Application: injection into the bloodstream; followed by a cholinesterase reactivator (2-PAM chloride)

> *Attention:*
>
> *As the employed chemical weapons can have an immediate effect or can not be smelled the warning signal ("GAS") must be reacted on immediately!*

**After an attack with chemical weapons and during actions in contaminated terrain:**

- ➥ **Avoid contact with chemical warfare agents**
- ➥ **Do not allow chemical warfare agents to enter clean areas**
- ➥ **Decontamination is needed to eliminate the hazard, if material and personnel are exposed to persistent chemical warfare agents**
- ➥ **Seek qualified medical advice for those persons who have been harmed by warfare agents**
- ➥ **Do not eat, drink or smoke on contaminated terrain**

> *Attention:*
>
> *Keep strict NBC defence discipline!*
>
> *Don't panic!*

## 4.3 General signs of the use of chemical weapons

- **Spraying of chemical warfare agents from slowly and low flying aircrafts:**
  Light to dark coloured clouds behind the aircraft
- **Aerosol generators:**
  Dropping of the aerosol generators on parachutes and then ignition (automatically shortly above the ground; contact fuse; time fuse)
- **Chemical bombs, missiles, shells:**
  Muffled detonation;
  white-grey to brown detonation clouds;
  forming of drops and greasy (warfare agent) patches in the area surrounding the detonation
- **Smoke or fog clouds coming with the wind**
- **Further characteristics:**
  - Oily drops, patches, etc. on the ground, vegetation and other objects
  - Wilted vegetation or changes in the colour of the vegetation
  - Discolouring of snow
  - Finding of dead small animals

### 4.4 Behaviour in the case of an attack with chemical weapons

- ➥ Put on the NBC protective mask immediately
- ➥ Enter a protective building or cover your body with NBC protection foil or put on complete NBC protection equipment
- ➥ Forward the announcement / warning about the chemical weapon attack
- ➥ Aid injured persons putting on their NBC protection equipment
- ➥ Remove warfare agent drops (use of self-aid or self-decontamination kits)
- ➥ Organisation of immediate first aid (self aid and mutual aid), early stabilisation (life support) of casualties, and rapid evacuation if necessary
- ➥ Carry out immediate or thorough decontamination taking the situation into consideration.

**Don't panic!**

## 5 NBC defence

### 5.1 Individual NBC Protection

It is absolutely necessary that everybody is provided with effective individual NBC protection equipment when carrying out actions under NBC conditions.

The individual NBC protection equipment consists of

- NBC protection mask
- NBC protection suit
- NBC protection gloves
- NBC over-boots
- NBC protection foil for one-way use
- NBC Self-Aid Kit
- Further parts of equipment necessary for personal NBC protection
  - autoinjector with antidotes
  - agents for prophylaxis against nerve affecting warfare agents
  - detection paper, etc.

When put on in time, the individual NBC protection equipment protects against all gaseous and liquid chemical warfare agents as well as biological warfare agents and renders direct contact of the skin with radioactive particles impossible. NBC protection on the basis of insulating (rubberised) protection suits without integrated ventilation systems as well as permeable (breathable) NBC protection suits to be worn over the uniform (NBC overgarments), are unacceptable, under the climatic conditions of hot climatic zones, as the physiological wearing properties (heat stress, etc.) do not allow actions for a long time. The wearing properties of a combat suit with integrated NBC protection enable its wearer to use it as a normal combat suit in peace time during daily service in the barracks, training in terrain, and especially during manoeuvres.

The individual NBC protection equipment offers the necessary protection only if everybody

- ➥ is provided with a complete set of personal NBC protection equipment
- ➥ keeps all parts of the protection equipment ready for use
- ➥ masters the timely and effective use of the protection equipment
- ➥ is psychologically and physically able to continue actions while wearing NBC protection equipment

at any time.

### 5.2 Collective NBC Protection

To reduce actions of the personnel wearing complete personal NBC protection equipment to a minimum, to keep personnel losses as low as possible, to maintain parts of the troops fit for action, and to set the basis for the continuation of the military objectives and civil actions, different collective NBC protection equipment must be employed, like:

- Collective NBC protection of tanks, vehicles, etc.
- Collective NBC protection of infra-structure (command plants, depots, shelters)
- Transportable systems with integrated NBC protection (shelters/tents)
- Shelter systems for civilians with integrated NBC air supply.

### 5.3 NBC Detection

Chemical and biological warfare agents as well as nuclear radiation can not or only be perceived when their effects leave symptomatic phenotypes on the human or animal organism. The detection equipment must detect a possible contamination of personnel, material or terrain, measure its intensity, alarm the troop automatically in case of contamination, and derive the necessary conclusions and consequences for the continuation of action on the basis of the found information.

Due to the specific appearances of the biological warfare agents, a safe, field proof is in general impossible. This is why in practice the means of biological detection are limited to devices for taking samples. The analysis of the samples is carried out in special laboratories, for instance laboratories belonging to the medical service, and require quite a long time. Usually, the relevant test results are only available after 24 hours.

*Adequate NBC detection is needed to ensure that adequate protective measures can be taken in time.*

### 5.4 NBC Decontamination

#### 5.4.1 General aspects

- **N decontamination**

  (radioactive decontamination) means the elimination of radioactive particles adhering to the surface (fall-out). The most effective way of radioactive decontamination is the hot-foam method.

- **B decontamination**

  (disinfection) means rendering biological warfare agents harmless. Highly effective disinfection solutions are suitable for carrying out this task.

- **C decontamination**

  (detoxification) means the elimination or destruction of chemical warfare agents. Highest effectivity is achieved with detoxification emulsions working universally against all known chemical warfare agents.

Depending on the kind of contamination, specific decontamination agents and methods are necessary for fulfilling the decontamination requirements effectively.

A decontamination site must have the following stations:

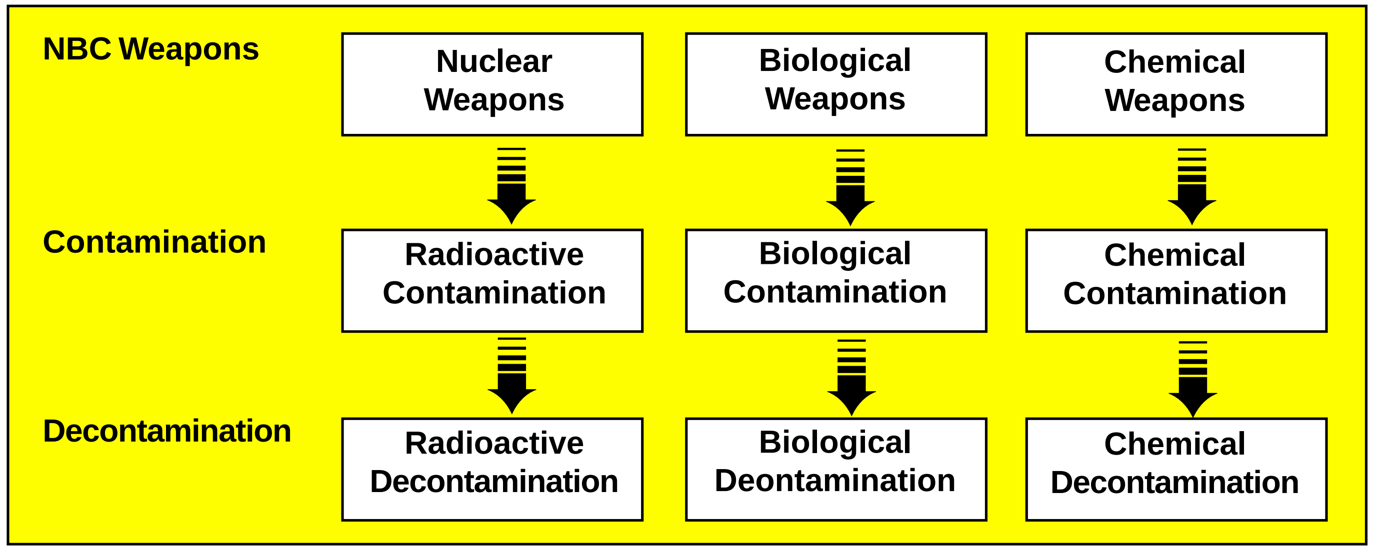
**(1) decontamination of material**
with the substations:

- pre-treatment
- main treatment
- post-treatment

**(2) decontamination of persons**

**(3) decontamination of clothing and equipment**

The aim of a thorough decontamination is to destroy chemical and biological warfare agents and remove radioactive particles from the surfaces of different objects or to render them harmless to avoid a direct or indirect contamination of the personnel in order to enable them to continue their actions without wearing individual NBC protection equipment.




### 5.4.2 General principles for decontamination

- Decontamination of persons always takes precedence over the decontamination of material
- Decontamination should always be carried out outside the contaminated terrain
- NBC protection should be removed only after thorough decontamination
- Decontaminate the urgently needed material first
- Carry out detoxification (C decontamination) as soon as possible, but at the latest 4 to 6 hours after the CW attack
- Set up the decontamination site close to a water source
- Set up the decontamination site strictly observing the wind direction:

  *Always avoid recontamination of surfaces that have already been decontaminated!*
- Strict separation of "black" and "white" area
- Prevention of spread of contaminants out of the "black" area
- Decontamination of vehicles:
  Always decontaminate from front to rear and from top to bottom!
- Decontamination of persons:
  Short shower time (1 to 3 minutes) and low shower water temperature (approx. 28 °C)
- Undressing of the NBC protection clothing:
  Avoid contact of contaminated parts with unprotected skin!

*Attention:*

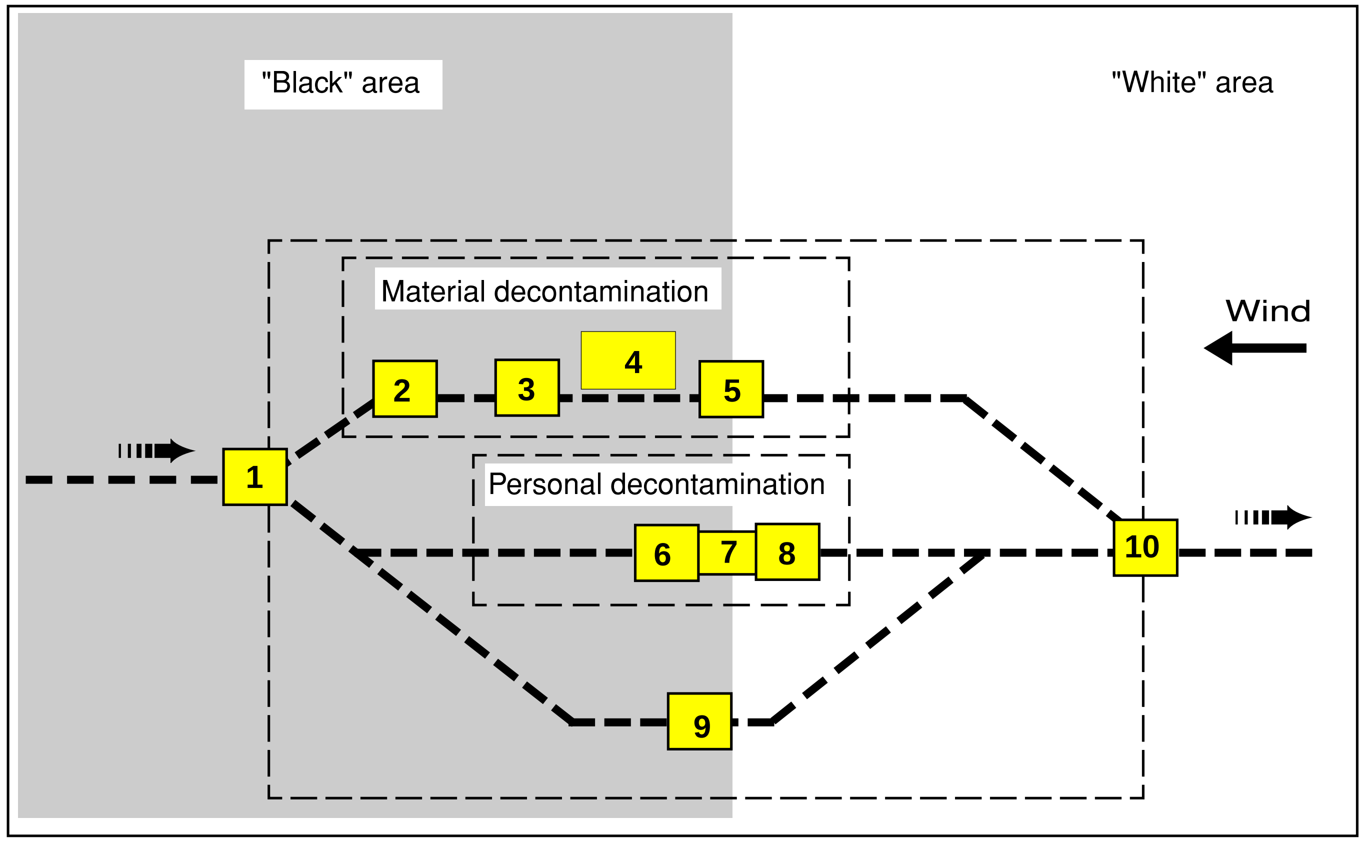
*These principles are also valid for decontamination in the case of accidents with highly toxic/hazardous materials*

### 5.4.3 NBC decontaminats (Selection)

| Decontamination | Decontaminant | Remarks |
|---|---|---|
| **N decontamination** | (1) aqueous solution of alkylbenzenesulphonate and Di-Na-EDTA | 0,5 - 1 % Alkylbenzenesulphonate<br>0,5 - 1 % Di-Na-EDTA |
| | (2) aqueous solution of soap and detergents | powdered soap; washing powders; general purpose liquid detergents; as aqueous solution (0,5 - 1 %) |
| | (3) aqueous solution of Kärcher RM 54 | 0,5 - 5 % RM 54 |
| **B decontamination** | (1) aqueous solution of formalin and soap | 3 - 5 % formalin |
| | (2) aqueous solution of Kärcher RM 35 | 0,75 - 7,5 % RM 35 |
| **C decontamination** | (1) "German Emulsion" ("Munster-Emulsion") | 7,5 % caliumhypochlorite<br>15 % tetrachloroethylene<br>1 % emulsifier Marlowet IHF<br>76,5 % water<br>consumption: 3 - 6 l $m^{-2}$<br>reaction time: 30 min |
| | (2) Kärcher Decon Emulsion TDE 202 | 12 ± 2 % TDE 202 PC<br>12 ± 2 % TDE 202 LC<br>76 % water<br>consumption: 3 - 6 l $m^{-2}$<br>reaction time: 30 min |
| | (3) DS 2 | 70 % diethylenetriamine<br>28 % methyl cellosolve<br>2 % sodium hydroxide<br>consumption: 0,2 - 0,3 l $m^{-2}$<br>reaction time: 30 min |
| | (4) water slurry of chlorinated lime | 10 % chlorinated lime<br>consumption: 3 l $m^{-2}$<br>reaction time: 15 min |
| | (5) thin water slurry of Super Tropical Bleach (STB) | mixture of chlorinated lime and calciumoxide<br>content of available free chlorine: 30 - 37 %;<br>reaction time: 30 min |
| | (6) water slurry of calcium hydroxide and calcium hypochlorite | 10 % decontaminants<br>content of available free chlorine: min. 60 %<br>consumption: 3 l $m^{-2}$<br>reaction time: 15 min |
| **Personal C decontamination** | (1) Decontaminating Powder | mixture of chloride of lime and magnesia<br>reaction time: 15 min |
| | (2) Fuller's Earth | aluminosilicate powder |
| **Non-standard decontamination chemicals** (examples) | - monochloramine B and T<br>- dichloramine B and T<br>- hexachloromelamine<br>- ammonium hydroxide<br>- sodium or potassium hydroxide | as aqueous solution |
| | - sodium carbonate<br>- peracetic acid<br>- acetone<br>- diethyl ether<br>- gasoline<br>- diesel fuel<br>- kerosene<br>- ethylene glycol | as solvents for chemical warfare agents |

## 5.4.4 General organisation of a decontamination site

1 Control point
2 Material decontamination - Pre-treatment
3 Material decontamination - Main treatment
4 Material decontamination - Reaction time
5 Material decontamination - Post-treatment
6 Personal decontamination - Undressing
7 Personal decontamination - Showering
8 Personal decontamination - Dressing
9 Decontamination of clothing and equipment
10 Assembling area




## 5.5 Medical NBC Protection Measures

Medical NBC protection includes all measures of prophylaxis, diagnosis as well as first therapeutical measures under field conditions, in order to keep the effects of an attack with NBC weapons on the health of the concerned personnel as low as possible.

In addition to the conditions that a clinical surrounding should fulfil in principle, mobile and stationary field hospitals must be designed so that the relevant clinical tasks can also be carried out under NBC conditions. This requires an over-pressure system based on an NBC protected ventilation system.

However, effective care of NBC injured persons means decontaminating them first. Therefore field hospitals must be connected or equipped with a decontamination system (meaning material as well as qualified personnel) which is especially intended for the decontamination of wounded persons. Apart from this, a possible spread of NBC contamination into the hospital area must be reliably prevented.

## Annexes

**Dependence of the luminous period on the nuclear detonation strength**

| Detonation strength [ kt TNT] | Luminous period [sec] |
|---|---|
| 1 | 1 |
| 10 | 2,2 |
| 100 | 4,6 |
| 1000 | 10 |

**Symptoms of a heat stroke:**

- headache
- feeling of dizziness and weakness
- tendency to faint and hallucinations
- dopey states
- cramps
- paralysis of respiration, and heart and circulatory failure (death)

**Possible wearing time of insulating individual NBC protection equipment, depending on the meteorological conditions**

| Air temperature | Possible duration of activities under insulating individual NBC protection equipment | |
|---|---|---|
| | in direct sunlight | in shade, cloudy, windy weather |
| ≥ 30 °C | 15 - 20 minutes | 20 - 30 minutes |
| 25 - 29 °C | 30 minutes | 45 minutes |
| 20 - 24 °C | 40 - 45 minutes | 60- 70 minutes |
| 15 - 19 °C | 1,5 - 2 hours | 2 - 3 hours |
| < 15 °C | > 3 hours | 4 - 5 hours |

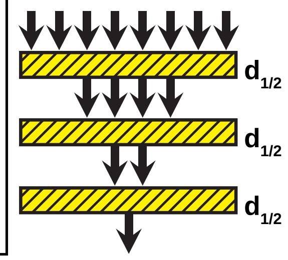
*Attention:*

*Limit the wearing of the personal NBC protection equipment to the possible minimum (especially at extremely high outside temperatures)*

**Overview of the decrease of nuclear radiation** (approximate values)

| Matter | Density | Half-value layer $d_{1/2}$ for gamma radiation | Half-value layer $d_{1/2}$ for neutron radiation |
|---|---|---|---|
| Air | 0,0013 g cm$^{-3}$ | 250 m | |
| Snow | 0,3 - 0,6 g cm$^{-3}$ | 50 cm | |
| Wood | 0,7 g cm$^{-3}$ | 15 - 40 cm | 10 - 15 cm |
| Water | 1,0 g cm$^{-3}$ | 23 cm | 3 cm |
| Earth | 1,6 g cm$^{-3}$ | 10 - 18 cm | 9 - 14 cm |
| Concrete | 1,9 - 2,8 g cm$^{-3}$ | 6 - 13 cm | 8 - 12 cm |
| Brick | 1,4 - 1,6 g cm$^{-3}$ | | 10 - 14 cm |
| Steel | 7,8 g cm$^{-3}$ | 2 - 3 cm | 5 - 12 cm |
| Lead | 11,3 g cm$^{-3}$ | 1,4 - 2 cm | 9 - 20 cm |
| Polyethylene | 0,92 g cm$^{-3}$ | 15 - 30 cm | 3 - 6 cm |

**Half-value layer** $d_{1/2}$ = thickness of a material layer which reduces the intensity of radiation by half




**Nuclear radiation sickness**

Acute radiation damage to persons is only visible after exposure to very high doses

| Symptoms | | Radiation dose [Gy ] | | | | | |
|---|---|---|---|---|---|---|---|
| | | 0,1 - 0,3 | 0,3 - 1 | 1 - 3 | 3 - 6 | 6 - 10 | > 10 |
| Exhaustion | | no | occasional | moderate | strong | very strong | extreme |
| Nausea, vomiting | | no | occasional after 2-6 hrs | several times | often | often, strong | permanent |
| Headache | | no | no | temporary | permanent | permanently strong | torture |
| Consciousness | | clear | clear | clear | clear | gloomy | no clear |
| Body temperature | | normal | normal | normal | normal | subfebrile | febrile |
| Prognosis | without treatment: | very good | very good | good | unsure | low chance of survival | no chance of survival |
| | with treatment: | very good | very good | very good | good | unsure | low chance to survive |

### Negligible risk for NBC contamination

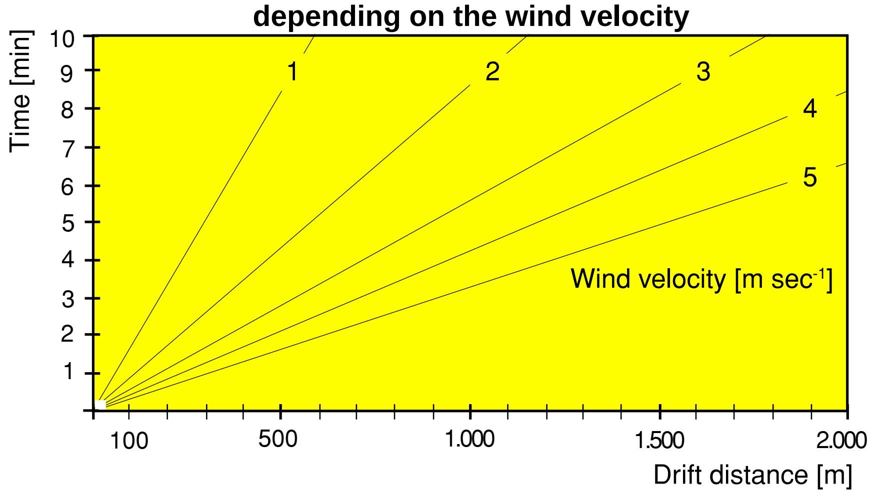
| Kind of contamination | Contaminant | Contamination | |
|---|---|---|---|
| | | Vapour or aerosol | Liquid |
| **N** | radioactive fallout | 0,25 Gy | 0,25 Gy |
| **B** | biological | < 500 spores per $m^2$ | < 500 spores per $m^2$ |
| **C** | HD | 50 mg min $m^{-3}$ | 2,5 mg $kg^{-1}$ |
| | GD | 2,5 mg min $m^{-3}$ | 0,044 mg $kg^{-1}$ |
| | VX | 0,25 mg min $m^{-3}$ | 0,02 mg $kg^{-1}$ |

### Measuring units (radioactivity)

| Description | Unit [SI] | Definition | Relation to other units |
|---|---|---|---|
| Activity | Becquerel [Bq] | Quantity of nuclear decays per second | 1 Bq = 1 $s^{-1}$<br>1 Ci = 3,7 x $10^{10}$ Bq |
| Energy dose | Gray [Gy] | Absorbed quantity of radiation per mass unit | 1 Gy = 1 J $kg^{-1}$<br>1 rd = $10^{-2}$ Gy |
| Equivalent dose | Sievert [Sv] | Energy dose multiplied by quality factor | 1 Sv = 1 J $kg^{-1}$<br>1 rem = $10^{-2}$ Sv |
| Energy dose rate | Gray per hour [Gy $h^{-1}$] | Energy dose per time unit | 1 rd $h^{-1}$ = $10^{-2}$ Gy $h^{-1}$ |
| Equivalent dose rate | Sievert per hour [Sv $h^{-1}$] | Equivalent dose per time unit | 1 rem $h^{-1}$ = $10^{-2}$ Sv $h^{-1}$ |

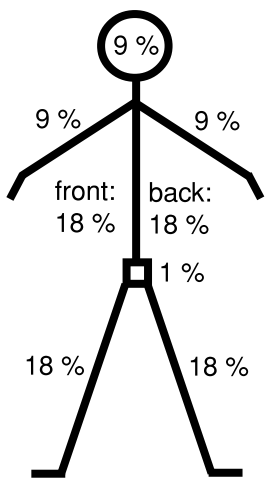
### Drift of a warfare agent cloud depending on time

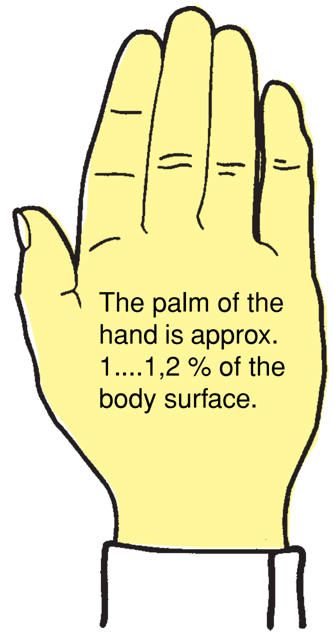
**Drift time of the CWA cloud depending on the wind velocity**




### Burns from heat radiation

**Evaluation of the surface extent of burns**
(according to WALLACE):




### Degrees of burns

| Degree of burn | Clinical description |
|---|---|
| **I** | **epidermal burns**<br>- erythem (damage of epidermis) |
| **IIa** | **superficial dermal burns**<br>- blistering<br>- weeping red wound surface |
| **IIb** | **deep dermal burns**<br>- white-yellowy colour of the skin<br>- sensitivity disturbed or not present |
| **III** | **full thickness burns**<br>- white-yellowy colour of the skin<br>- no sensitivity |
| **IV** | **subdermal burns** |

### Possible classifation of thermally damaged persons
(by nuclear and incendiary weapons)

| Level of urgency | Clinical description of the burn demages |
|---|---|
| **I** | burns of the respiratory tract, of the head and the throat |
| **II** | burns of 20 to 50 % of the body surface |
| **III** | burns of 10 to 20 % of the body surface |
| **IV** | burns less than 10 % of the body surface |
| **V** | deep burns of more than 50 % of the body surface |

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## Kärcher's Activities in the Area of NBC Defence:

- ➥ **NBC Defence Conceptions for Armed Forces and Civil Defence Organisations**
- ➥ **NBC Defence Consulting**
- ➥ **Development, Production and Delivery of NBC Defence Equipment**
- ➥ **Worldwide Service**
- ➥ **NBC Defence Training Courses**

KÄRCHER

# Product Range Special Customers

## Product Group 1: Protection Systems

**Textile protection systems:**
Safeguard™ 2002-HP NBC protective clothing
Safeguard™ 3002-A1 NBCF protective clothing
NBC protective gloves
Safeguard 6002 full protection clothing
Fireguard fire-fighting clothing

**Decontamination modules:**
MPS 3200
MPDS
DADS
EDADS

**Decontamination agents:**
TDE 2000 detoxification emulsion
TDE 202 detoxification emulsion
GDS 2000 detoxification agent
Di 60 detoxification agent
RM 21, 35, 54 decontamination agents
Training emulsion

**Decontamination devices:**
DS 10 decont sprayer
Mediclean 2000

**Decontamination systems:**
CDS 1000 decontamination trailer
Decocontain 3000
Decocontain 3000 ELV
Decont Jet 21 for large vehicles
DSSM for sensitive material
Decont Shuttle

## Product Group 2: Field Camp and Maintenance Systems

CFL 60 containerised field laundry
TFL 25 trailer field laundry
USC AB-DEKO environmental protection container
SPS 2000 long-term preservation system

HDS 1200 EK high-pressure cleaner
HDS 1400 D high-pressure cleaner
SCS 1800 DE high-pressure cleaner
FB 20 field heating system
FB 60 field heating system

## Product Group 3: Mobile Catering Systems

**Field kitchen systems:**
TFK 250 tactical field kitchen
MFK 2/98 modular field kitchen

**Small cooking units:**
FKU 25 mobile field cooking unit

**Field kitchen burners:**
Multi-fuel burner
Gas burner

**Accessories:**
Transportable food container

**Cooking modules:**
CD 10 mobile combi-steamer
Mobile cooking kettle
Mobile frying kettle
Mobile frying/baking module
Mobile refrigerator module

**Container systems:**
HMCK mobile container kitchen
VORCON mobile food preparation container
Mobile canteen container

## Product Group 4: Water purification

**Drinking water purification systems:**
Waterclean 500
Waterclean 1600
Waterclean 3200

Containerised water purification systems


Number 1 in NBC Defence
Revolutionary Kärcher Technology
futuretech
Decont Jet 21
The first automatic decontamination system with laser contour recognition in the world. Highest safety standard due to tests carried out by NBC defence experts of the