

Abstract

Self-preparation guide for 2gr students.

Subject: "Safety science"

Topic 1.3 "Safety arrangements of civil population in the case of emergency or armed conflict. Individual protective equipment."

1. Safety arrangements in the case of armed conflict, main principles and means.

There are some basic principles of public safety management:

1. **Principle of universality** is the main principle of public safety in the case of emergency. This principle means the universality of all arrangements, which aim is to decrease the damage of accident.

2. **Principle of differential action.** This principle takes into account features of different regions, cities or villages.

3. The most important principle is **principle of beforehand action.** Arrangements and engineering measures with the aim to prevent the harmful impact of damage factors.

4. **Principle of integrated approach** means the effective application of all security facilities and means from damage factors.

Safety of civil population in the case of emergency is achieved by following means:

- Protective constructions (shelters);
- Evacuation of population;
- Individual protective equipment;

Population protection management:

- Warning system;
- The reserves of protective shelters;
- Initiation and conduct of evacuation efforts;
- Maintenance with personal protective equipment;
- Security standards education;
- System of foodstuffs and water defense from damage factors;
- System of radiological, chemical and bacteriological control and intelligence;
- Preventive measures.

Questions for self - control.

1. Main principles of civil safety arrangements in the case of armed conflict.
2. Main principles of civil safety arrangements in peacetime.
3. Safety arrangements in the face of an attack.
4. Safety arrangements in the case of evacuation.
5. Safety arrangements in the case of war.

2. Characteristic of protective constructions.

Protective structures were designed primarily to protect the population (shelters), and to ensure the readiness of civil protection resources (protected premises) during an armed conflict, especially one involving weapons of mass destruction. They provide a basic form of protection against a wide range of direct and indirect arms impact. They should also be available in the case of disasters and emergencies, for example increased radioactivity, an earthquake and etc.

Protective constructions for civilians, types;

- Shelters
- Anti-radiation shelters
- Primitive covers

2.1 Shelters.

Shelters are protective constructions from danger or attack, shelters are used in the face of threat or in the case of emergency.

Shelters protect:

- - employees of potentially hazard objects (e.g. employees of oil-processing plant)
- - employees of organizations located in possible destruction zone
- - non-transportable casualties
- -other people

The level of protection in response to blast loading defines the extent of damage and debris that may be sustained in response to the resulting blast pressures and impulses.

There are 4 classes of shelters according to their defense effectiveness. Defense effectiveness is the ability of shelter to withstand the shock-wave pressure. Shock-wave pressure is measured in kg per square cm or in kPa (kilopascals)

Table 1.

Classification of shelters according to their protective class.

Class	Defense factor	Shock-wave pressure (kPa)
1	> 5000	Low than 500 kPa
2	> 3000	Low than 300 kPa
3	>2000	Low than 200 kPa
4	> 1000	Low than 100 kPa

Also, there are different classifications of shelters according to the location, siting, expected capacity etc.

According to the building conditions, there are early upbuilt shelters and rapidly built shelters in the case of emergency.

According to the capacity there are constructions of low (75-300 occupants), medium (300-1000 occupants) and large capacity (for more than 1000 occupants).

According to the location shelters can be independent from buildings (standalone) or deeper part of existing buildings is used as shelter or safe room (internal).

There are several possible locations in a building or a house for a shelter. Perhaps the most convenient and safest is below ground level, in a basement.

Standalone shelter:

- Separate building that is designed and constructed to withstand the range of natural and manmade hazards.
- It is sited away from potential debris hazards.

-It will be structurally and mechanically separate from any building and therefore not vulnerable to being weakened if part of an adjacent structure collapses.

-It does not need to be integrated into an existing building design.

An internal shelter is a specially designed and constructed room or area within or attached to a larger building that is designed and constructed to be structurally independent of the larger building and to withstand the range of natural and manmade hazards.

Requirements for shelters:

- 1) Shelters should provide human safety from all damage factors;
- 2) Shelters should withstand excess pressure not less than 100 kPa;
- 3) Shelters should provide human staying not less than 2 days;
- 4) Shelters should provide hygienic and sanitary conditions for people: air temperature may not exceed 28-32 degrees, relative humidity may not exceed 90 %;
- 5) Water and food supply;
- 6) Floor-to-ceiling height shouldn't be less than 1.7 m;
- 7) Protected entrances.

Shelters must include ventilation systems capable of providing the minimum number of air changes, also they must include sewerage, energy and water supply, heating, detection-alarm-communication system, sleeping areas (if occupancy duration is greater than 24 hours).

Occupancy duration (also known as button-up time) is the length of time that people will be in the shelter with the doors closed and in the protected environment. This period of time is determined by the building owner or local authorities and can range from several hours to several days. For off-site industrial accidents, the occupancy duration is usually less than 24 hours; occupancy durations longer than 24 hours are generally restricted to wartime.

Table 2

Sanitary-hygienic standards for shelters

Recommended standards for 1 occupant	Shelters for	
	Population	Patients
Square, m ²	0.4-0.5	0.75 for sitting case and 1.9 for litter case
Volume of space, m ³	1.5	2
Air exchange (ventilation) m ³ /hour	2-10	10
Temperature (climate), °C	19-25	20-23
Water supply, l/day.	3	20 for 1 patient and 3 for nurse
Oxygen (%)	More than 19	More than 19
Carbon dioxide (%)	Less than 2	1-2
Humidity (%)	60-80	60-70

2.2. Fallout shelters

The purpose of a fallout shelter is, of course, to shield the people inside from the harmful effects of radiation in the case of emergency.

Requirements for fallout shelters:

1. Shields of fallout shelter must reduce radiation exposure;
 2. All apertures need to be walled up after entrance of all occupants;
 3. Their closeness to human staying.
- The simplest example of anti-radiation shelter is underground cellar

It is necessary to build fallout shelters in peacetime, but in the face of radioactive threat they need to be upbuild rapidly using industrial, building and other local materials. Square footage standards for rescue shelters are the same as for other

shelters. What concerning entry doors, they are made from usual materials, but all apertures need to be walled up properly.

Heating system in fallout shelter is common with central heating system of the hole building. It should be able to be switched off if there is such need. Temperature in cold season should not be less than 10°C before occupation.

Water mains should provide water supply in fallout shelter with the standard of 25 liters for 1 person. If the water supply is absent, standard is for only drinking water (about 2 liters for 1 person from handheld tank).

2.3 Primitive covers

Primitive covers are built in the face of emergency for those, who isn't provided with special protected premises.

- Primitive covers are open and closed trenches. They can be modified in shelters or fallout shelters in some cases. Closed trench with dirt fillin 60 cm reduces radioactive exposure in 50 times.
- Occupancy requirement is 10-40 persons.
- Trenches are built with ditcher trenchers or by hand.
- The depth of open trenchers is about 1,5 m, the width is 1,1-1,2 m, the length – 0,5 m in the rate for 1 person
- It is necessary to dig a trench far from potential avalanche in the case of explosion, but not so far from those people who might use trenches in the case of emergency (e.g. recommended distance for digging a trench is half the height of the building plus 3 m)
- It is necessary to use individual protective equipment, special protective clothing in trenches, because open trenches don't protect from radioactive, bacterial, chemical materials and some warfare agents. Closed trenches are able to provide only partial defense, therefore it is also necessary to use some individual protective equipment.

Questions for self-control.

1. Shelters. Classification. Types.
2. Sanitary requirements for shelters.
3. Fallout shelters. Characteristic of fallout shelters.
4. Primitive covers. Characteristic of primitive covers.

3. Individual respiratory organs protective devices.

Types of individual respiratory organs protective devices:

- Gas masks
- Respirators
- Self-rescue devices
- Some primal means

Recent respirators are available to ensure appropriate protection for respiratory organs and eyes from harmful impact of poisoning agents and radioactive dust.

Types of gas masks according to their working principle:

- filtering protective mask – air purifying respirator
- self-contained breathing apparatus – isolating gas-masks

3.1 Air-purifying respirator

The most common device is an air purifying respirator. It protects respiratory organs, eyes, face from toxic agents (chemical, biological and radioactive).



- The working principle of air-purifying respirator based on the working principle of filter box.

Filter box: absorbent coal and antismoke filter.

The structure of air-purifying respirator

- Filter box and face part. Filter box contains absorbent coal (as a batch) and antismoke filter;
- Hopcalite cartridge

Pic 1. Air-purifying respirator

After inhaling contaminated air goes in filter box, purifies there and then runs under the face part and in respiratory organs. While exhaling the air goes outside the mask past the box.

There are 5 heights of face helmet of air-purifying respirator:

63 cm – 0 size

63,5-65 cm – 1 size

65,5-68 cm - 2 size

68,5-70,5 cm– 3 size

71,5 and more – 4 size

To choose right size of helmet you should measure your head through the chin and the top of the head and the distance between mandibular angles and jugal bones.

Toxic and poisoning agents are completely delayed in the filter box for a while. But after a while some trails of toxic agents appear in the air from the box. This means protection depletion of respirator. This time before traces appearance is called gas mask protective capability.

3.2 Isolating gas-masks. Self-contained breathing apparatus



Pic.2 Self-contained breathing apparatus

- Self-contained breathing apparatus isolates respiratory organs from outer air. The act of breathing arises from disengaging air from oxygen cylinder.
- These devices are used in the case of high concentration of toxic agents or unknown warfare agents in the air, when air-purifying respirator doesn't provide proper defense because of the risk of penetration of traces under the mask. Also, they are used for breathing under water (e.g. aqualung).

2 types of isolating gas-masks according to the principle of oxygen maintenance:

- Pneumatogen: regenerating cartridge and reservoir bag;
- Pneumatophore: balloons with compressed air compound.

All pneumatogens have regenerative cartridge. Regenerative cartridge absorbs carbon dioxide from exhaling air and provides inhaling air with oxygen. The disadvantage of this device is respiratory resistance.

Pneumatophore has special balloons with compressed air (e.g. aqualung)

Isolating gas masks provide defense from highest concentration of toxic agents, so they cost more than air-purifying respirators.

Employees of chemical enterprises, gas rescue service, which activity is associated with toxic and dangerous agents are provided with isolating gas masks.

Isolating gas masks are reusable devices, regenerative cartridges or balloons are replaced with new ones according to their deterioration.

3.3 Self-rescue devices



Pic. 3 Self-rescue device

- Self-rescue devices are used for short-time chemical protection (e.g. during emergency escape from contaminated area)

It is simple to use self-rescue devices even without special training. It is convenient to carry them around because of their small weight.

Self-rescue devices are disposable devices for uneducated staff.

Construction of self-rescue device:

- regenerating cartridge and reservoir bag with pressure isolation valve

3.4 Respirators.



Pic. 4 Respirator

Respirators defense from aerosols and dust (including radioactive dust).

There are disposable and re-usable respirators (with filter changing system)

3.5 Primal protection means.

Primal protection means are used as respirators by civilians. Primal protection means are simple to make and use, (e.g. bulky dressing from gauze and cotton).

Requirements for bulky dressing:

- For disposable use only;
- Piece of gauze with the length 100 cm and the width about 50 cm with the piece of cotton in the middle of dressing;
- Bulky dressing should be fixed tight with the tapes.

Questions for self-control.

1. Individual respiratory organs protective devices. Types.
2. Characteristic of air-purifying respirator.
3. Isolating gas mask. Characteristic.
4. Self-rescue device. Characteristic.

5. Respirators. Characteristic.

6. Primalprotectionmeans. Characteristic.

Practice part

How to put on an air-purifying respirator properly.

Table 2.

<p>Choose the right size of face helmet.</p>	<p>It is important to choose right size of face helmet. If the helmet is smaller than you need, there is the risk of blood supply disturbances, you may feel dizziness and headache.</p> <p>If thehelmet is bigger, there is the risk of penetration of toxic agents and poisoning.</p> <p>Measure your head through the chill and the top of the head to choose rightsize, also measure the distance between mandibular angels and the distance between jugal bones.</p> <ul style="list-style-type: none"> • There are 5 heights (sizes) of face helmets: <ul style="list-style-type: none"> 63 cm – 0 size 63,5-65 cm – 1 size 65,5-68 cm - 2 size 68,5-70,5 cm– 3 size 71,5 andmore – 4 size
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Action	Contents
<p>1. How to put on the helmet of air-purifying respirator.</p>	<p>1. Choose the right size of the helmet.</p> <p>2. Check the integrity. Check the condition of face part.</p> <p>3. Make sure there are no dents or punctures on filter box.</p> <p>*Change the respirator in the case of any damage.</p> <p>*Air-purifying respirator in good working condition is placed in special bag with filter-box down.</p>

<p>2. How to take off the respirator:</p>	<p>The order of respirator donning:</p> <ol style="list-style-type: none"> 1. Hold your breath without inhaling in response to a command “Gas” 2. Close your eyes. 3. Pull out the respirator from the bag. 4. Take the respirator in a such way, when your thumbs are outside the helmet, other fingers are inside. 5. Pull out the valve from the filter. 6. Apply the lower part of the helmet to the chin. 7. Put on the mask quickly. 8. Examine the absence of any folds on the surface of helmet. 9. Open your eyes. 10. Exhale, begin to breath. <p>- Act in response to a command “All clear”</p> <ol style="list-style-type: none"> 1. Lift the headgear with one hand. 2. Take off the helmet with other hand holding down the valve box. 3. Put on the headgear. 4. Turn the helmet inside out and put it in the bag.
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