

CURRENT REQUIREMENTS TO THE SAFETY MEANS FOR THE PARTICIPANTS IN FIRE EXTINGUISHING FOR CRITICAL INFRASTRUCTURE SITES

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Abstract: This report discusses the current problems related to the equipment for personal protection of employees from fire safety and civil protection, part of the unified rescue system, for incidents in critical infrastructure sites. It is emphasized on the types of protective equipment used in general or specific fire extinguishing activities. The specific requirements are applicable to the design and manufacture of the individual protection devices, which will ensure the proper appearance and the highest possible level of fire safety in the extinguishing operation, without being an obstacle for his moves during work, despite direct exposure to danger for the parts of his body.

Key words: protective clothing, fire, infrastructure

1. INTRODUCTION

The security of the continued functioning of critical infrastructure achievements is crucial for society, especially in the storage of debris; Any unnecessary maintenance of central and local government buildings, schools, hospitals, financial institutions, power plants and schools etc. can lead to a serious upset of people's lives in the regions and in others like anyone who knows the number of casualties and economic losses. [1,2] In this respect, it equates to firefighters to protect the population if desired by human beings, incl. terrorist, action or natural forces is important.

Firefighters are exposed to a direct risk to their health and life in firefighting and rescue operations in various small and critical infrastructure sites. [3,4]

To protect themselves from burns and serious physical injuries, they use various types of personal protective clothing. Different types of protective clothing and equipment for firefighters have been developed, depending on the environment of the fire, what part of the body they are protecting, the purpose (upper or lower), composition and protective properties. They may be clothing and equipment for general firefighting activities, clothing and equipment with reflective properties, chemical protection suits, signaling with high visibility, radioactivity protective clothing, mountaineering clothing, as well as clothing which doesn't melt and is intended for wearing underneath basic protective clothing and more[5].

The firefighter's protective clothing used in general or specific firefighting activities is a special clothing for the protection of the neck, hands to wrists, feet to ankles, upper and lower part of the firefighter's body, without the head, forearms to the hands and feet, below the ankles from heat, pollution, wetting, wind and other harmful effects [6].

The primary role of these garments is to protect the firefighter in carrying out common firefighting and rescue activities while limiting and eliminating fires, limiting the effects of disasters, accidents, catastrophes, terrorist attacks, protecting sites from critical infrastructure, rescuing people and property. [7,8,9].

2. ANALYSIS

Providing firefighters with protective clothing and equipment is a major problem that has gained widespread publicity in late 2017 and early 2018.

Protective clothing, as part of personal protective equipment, must be used when handling health and safety risks that cannot be otherwise eliminated, as is the risk for firefighters [10,11,12,13]. The Health and Safety at Work Act determines that personal protective equipment must provide protection against dangers, not to be harmful to the health of the worker and not interfere with the performance of his or her duties.

Providing personal protective equipment to the firefighters means providing fireman's helmet, gloves, boots and belt, a breathing apparatus with a face mask and last but not least - a set of protective clothing for firefighters.

The firefighter's protective clothing must provide protection appropriate to the risks to which he is exposed daily and to the specifics of critical infrastructure sites. This protection can be achieved by using one piece of protective clothing or, as is

widespread in our country, a set of two parts - a hem and a trouser (pg. 1 and p. 2).



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Protective clothing must be designed in such a way as to provide the highest possible level of protection when used and to allow the firefighter to carry out his activities freely. It should not restrict his movements during work, despite his direct exposure to danger. In designing it, appropriate classes of protection should be introduced, taking into account different foreseeable conditions, distinguishing several levels for the same risk. It should exclude the possibility of risks and other undesirable effects when used.

The materials used to make the protective clothing and its components, including decomposition products, must not have a detrimental effect on the hygiene and health of the firefighter, as well as a negative impact on the environment when destroyed. The surfaces of any piece of protective equipment and clothing that are or may come into contact with the firefighter's body when used must not be rough or have sharp edges and protrusions that could cause severe irritation or injury during of their exploitation.

Protective clothing should not interfere the firefighter's movements in different positions of the body. When the firefighter is moving, protective clothing and equipment must not put him or her in danger, as well as his or her colleague working nearby.

Protective clothing for firefighters must be designed and manufactured in such a way that:

- to dress as quickly as possible and to adhere tightly to the body of the firefighter, as well as to leave it in place throughout the period of work with it, taking into account the high temperature, adverse environmental conditions, movements and positions of the body;

- to allow for adaptation to the firefighter's morphology by any appropriate means, such as adjusting and anchoring devices or by a sufficient variety of sizes.

Protective clothing and equipment for firefighters must be as light as possible without affecting the strength of their construction and their effectiveness when operating in or around high temperature and humidity areas. [14] They must also be strong enough to withstand the effects of direct fire and work in high temperature areas, as well as meeting the additional requirements of specific risks. They must have high-visibility retro-reflective strips

for the appropriate class of clothing, which must also meet the above requirements. [15].

Apparel and equipment must be put into service and accompanied by a manufacturer's instruction manual. Apparel (inside) shall be affixed with standard pictograms, including CE marking, proving their function as personal protective equipment for firefighters.



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The instructions for use must be comprehensive and contain the name and address of the manufacturer and / or his authorized representative, as well as the necessary information about:

1. storage, use, cleaning, maintenance, servicing and disinfection; the cleaning, maintenance and disinfection preparations recommended by the manufacturer, which must not have an adverse effect on the protective clothing and on the wearer when applied as directed;
2. the accessories to the firefighter's protective clothing and the characteristics of the modular clothing parts;
3. a class of protection corresponding to the level of risk and the corresponding restrictions on use;
4. the end date or the shelf life of the firefighter's protective clothing;
5. size table of firefighter protective clothing;
6. the importance of the markings used;
7. the normative acts applicable under Art. 2, para. 3 of the Regulation on conformity marking;

In determining the specific requirements for the protective clothing of the firefighter, in the person of the General Directorate of the Ministry of Interior, he / she shall comply with the legislation in force in the Republic of Bulgaria and, respectively, in the European Union.

To determine the requirements of the firefighter's protective clothing, the Bulgarian State Standard (BDS) Euronorm (EN) 469 [14] was created. The European Standard specifies minimum levels of requirements for the performance of protective clothing to be used in firefighting operations and related activities at critical infrastructure sites. They may be rescue activities or disaster relief respectively. Such clothing does not provide sufficient protection for operational activities related to the cleaning of the separated chemical products and gases.

The European Standard includes general requirements for the performance of clothing, minimum levels of performance of the materials used, and test methods to be used in determining those performance levels. The required levels of fulfillment can be achieved by using one or more different garments designed on a modular basis.

During the execution of their operational duties, firefighters may encounter other hazards other than those for which this standard provides protection, such as strong chemical, biological, radiation and electrical hazards. To protect against such hazards, it is necessary to develop and implement suitable kits for a specialized firefighter. In determining the requirements of the firefighter's protective clothing, the provisions of the regulations shall be taken into account as follows:

- defining the general requirements for ergonomics, safety, aging, size designation, compatibility and marking of protective clothing and for the information provided by the manufacturer of protective clothing - BDS EN ISO 13688 'Protective clothing. General requirements' [16,17];

- Test method for materials intended to be used in the manufacture of electrostatic protective clothing to avoid flammable electrical dilution - BDS EN 1149 'Protective clothing. Electrostatic properties' [18];

The test methods and requirements and their equivalents, the requirements for protective clothing intended to visually signal the presence of their user in order to ensure the visibility of the consumer in hazardous situations in all daylight conditions and in the illumination of traffic lights funds at night. The International Standard is applicable to low and medium risk situations.

It includes requirements for colors and reflectance, as well as the minimum area and layout of materials in protective clothing. BDS EN ISO 20471 'High visibility protective clothing. [19]

Requirements for the construction of protective clothing:

- be made of two parts - hem and trousers that overlap at least 15 cm when bent, stretched or rotated.

- allow easy and quick dressing and undressing.

- be multilayered, the outer layer being made up of high-protection materials and antistatic fibers, the intermediate layer should be made of a non-combustible, breathable membrane that protects against the ingress of liquids. The lining should be insulation made of non-combustible stitched material.

- be cleaned in washing machines at a certain temperature of the water and / or by dry cleaning without damaging their protective properties, the quality of the reflective tapes.

- be resistant to the penetration of liquid chemical products, prevent penetration into the inner surface of the garment and have the ability to repel. The resistance of the fabric and the seams must provide protection against the ingress of water and water vapor during direct quenching activities.

- be tensile to tear at the joints of the main joints of the material and must not be less than the specified regulatory requirements.

- must not resize (longitudinally and transversely), regardless of the number of cleanings.

Requirements for the materials of which the protective clothing should be made:

- the material must be treated for water tightness and temperature resistance to provide protection against water, heat, flame, sparks and cold;

- have the ability to remove moisture from the body of the firefighter, since in intense exercise the human body reaches states of profuse sweating;

- have a level of protection in accordance with the current legislation;

- have a tensile strength of the material when tested in the longitudinal and transverse directions, which must be within the specified values.



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The elements of the protective clothing (ch.3) must be of high-visibility reflective tape for the appropriate class of clothing. Reflective tapes should be placed on the chest, back, bottom of the hem, and across the sleeves and feet. The straps must be heat-resistant and must not prevent easy general cleaning of the garment.

The retro-reflective elements of the jacket are designed according to the user's requirements. Their material must be fluorescent with yellow, orange-red or red in color and in certain areas. Most often, one or two retro-reflective horizontal bands are placed around the body and two vertical ones are connected to the upper horizontal through the shoulders. If there are two horizontal bands, the absence of vertical bands is allowed.

The trousers of the trousers should have reflective strips that encircle each leg horizontally. The trouser straps may also be fitted with retro-reflective straps of at least 50 mm width.

Different undergarments are worn on the body under the firefighter's protective clothing under consideration. It may be special underwear and socks for firefighters or other appropriate undergarments. The firefighter's outfits offered are different from the usual ones in that they are sufficiently strong and more resistant to temperature and other adverse effects. Most often they are made of non-flammable jersey made of nomex material.

Of the above requirements for the firefighter's protective clothing, some have been adopted and are specific to the Republic of Bulgaria. These are the sizes and locations of reflective tapes, hem pockets and pants pockets, as well as the protection of zippers with self-adhesive tapes.

Requirements for the operation of protective clothing for firefighters During the actual operation of the protective clothing for firefighters, minimum requirements for their maintenance are stated. However, when used properly, these minimum requirements "extend the life" and maintain the quality of firefighter protective clothing for a minimum of 60 months, as provided for in the Ordinance on Essential Requirements and Assessment of Personal Protective Equipment [22].

Another basic criterion for the operation of firefighters' protective clothing is their proper storage under conditions suitable to preserve their protective functions, as well as the reflective properties of the tapes on them.

There are still some questions in the operation of protective clothing for firefighters that can only be answered by the garment manufacturer. These are questions regarding the frequency and cycles of washing clothes, their drying and storage, how long to expose them to direct sunlight during drying and storage, and the maximum shelf life. All these questions can be answered in the operating instructions of each individual protective clothing [21].

3. Conclusion:

1. The main problem is the lack of separate protective clothing for the firefighter, depending on the various types of threats in the sites of the critical infrastructure;
2. It is necessary to use new types of materials for the manufacture of the firefighter's protective clothing, providing complex protection against the dangers and risks that accompany his responsible activity;
3. The need to make improvements to the model and cut of protective clothing so as to ensure a higher degree of protection and protection against more harmful factors and freedom of movement.

By developing new materials and / or improving existing ones in an appropriate configuration, it will contribute to greater protection, comfort and safety of employees from specialized teams to protect sites from critical infrastructure.

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