



COMPARATIVE ANALYSIS OF THE EFFECTIVENESS OF INDIVIDUAL BALLISTIC PROTECTION MEANS USED IN THE RUSSO-UKRAINIAN WAR

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ABSTRACT: *The present scientific paper presents a comparative analysis of the different types of individual ballistic protection devices, particularly focusing on body armor used in the high-intensity conflict between Russia and Ukraine. With the advancement of technologies and the introduction of new tactics in modern conflicts, losses of personnel significantly increased. The use of effective individual ballistic protection devices substantially reduces these losses. The report examines the following parameters to compare different types of body armor: class of ballistic protection, weight, protective area, and comfort in use. To conduct the analysis, available literary sources, military reports, and feedback from the personnel of the countries involved in the conflict were studied.*

KEY WORDS: *individual ballistic protection devices, body armor.*

INTRODUCTION

The ongoing military conflict between Russia and Ukraine, which began in 2014 and escalated significantly during the period 2023-2024, has not only changed perceptions of the tactics used in modern high-intensity conflicts but has also highlighted the importance of individual ballistic protection devices used by military personnel in combat. One of the most crucial components of these protective measures are the body armors designed to protect the vital organs located in the torso, primarily from melee weapons, bullets, shrapnel, and secondary blast products.

With advancements in military technologies, the introduction of new types of weapons and ammunition, and changes in combat tactics, the effectiveness of individual ballistic protection devices under the extreme conditions of modern warfare needs to be analyzed and assessed [11].

The purpose of this paper is to draw conclusions about the effectiveness of the individual ballistic protection devices used in the war between Russia and Ukraine, which will serve as a basis for evaluating the devices currently deployed in our country's army, in terms of whether they meet the requirements of modern warfare.

The involvement of the Bulgarian Army in peacekeeping operations on one hand, and the preservation of the health of the personnel involved in such operations on the other, makes this research both timely and necessary.

Given the wide variety of body armors used in the conflict, the report will focus only on those that have been officially issued to the armies and are manufactured by the two countries involved.

1. INDIVIDUAL BALLISTIC PROTECTION DEVICES USED BY THE ARMED FORCES OF THE RUSSIAN FEDERATION

The body armors most widely adopted and commonly used in the armed forces of the Russian Federation are the following models: 6B23, 6B43, and 6B45.

1.1. Body armor 6B23

The 6B23 body armor is the oldest model used by the armed forces of the Russian Federation. It was introduced into service in 2013 and was the primary body armor until 2015, after which it was discontinued and replaced with the upgraded models 6B43 and 6B45. Despite this, the 6B23 body armor is still in use within the Russian armed forces.

The 6B23 body armor is manufactured by the company NPP "KLASS". It is available in several modifications:

- the basic modification of the 6B23 uses flexible elements based on 30 layers of TSVM-2 material;
- modification 6B23-1 includes an additional steel armor plate for the chest area in the set;
- modification 6B23-2 includes a ceramic plate "Granite-4M" for the chest area and a steel plate for the back in the set.

The weight of the 6B23 body armor varies from 4 to 10.2 kg, depending on the modification [2,3].

The 6B23 body armor is structurally composed of two sections: a chest section and a back section, each covering an area of 0.8 m². Each section has an



Fig. 1. Body Armor 6B23.

outer cover made from flame-retardant fabric on the inside and a wear-resistant material on the inner side. The covers are non-detachable, and they house the protective panels made up of 30 layers of aramid fabric TCBM-2. The body armor also features a special system for shock absorption and ventilation [4].

The weight of the 6B23 body armor ranges from 4 kg for the variant without armor plates, to 7 kg for the variant with ceramic plates, and 8 kg for the variant with steel plates [4].

The 6B23 body armor is produced in three sizes:

- size BJ 1 (БЖ 1) – accommodates chest circumferences up to 96 cm and heights from 158 to 172 cm;

- size BJ 2 (БЖ 2) – accommodates chest circumferences from 96 to 104 cm and heights from 172 to 182 cm;

- size BJ 3 (БЖ 3) – accommodates chest circumferences from 104 to 106 cm and heights from 182 to 188 cm [4].

In every variant, the 6B23 body armor provides protection against melee weapons, shrapnel from hand grenades, mines, and artillery munitions. In its chest section, where vital organs are located, the body armor has reinforced protection in two of its modifications. The standard steel armor plate protects against armor-piercing incendiary bullets for the 7.62×39 cartridge, fired from a "Kalashnikov" rifle at a distance up to 10 meters. The ceramic armor plate effectively withstands armor-piercing bullets for the 5.45×39 cartridges fired from an AK-74 rifle at a distance of 25 meters, as well as 7.62×54 cartridges with a steel core, fired from a "Dragunov" sniper rifle at a distance of 50 meters [4].

The back part of the 6B23 body armor provides protection against bullets from the 7.62×25 cartridge used in the TT pistol, as well as from hits by the modernized 7N16 ammunition for the "Makarov" pistol at a distance of 5 meters.

Based on the information provided, the following conclusions can be drawn regarding the class and level of protection offered by the 6B23 body armor and its modifications:

- the base model of the 6B23 body armor provides protection according to Class 2 (according to the European DIN standard), which means it offers protection from non-armor-piercing pistol bullets and small shrapnel;

- the 6B23-1 modification, equipped with a standard 6.5 mm thick steel armor plate [3] placed in the chest section, enhances the body armor's protection, resulting in Class 3 chest protection. This means it can withstand ammunition intended for rifles or assault carbines. The back section in the 6B23-1 modification retains Class 2 protection;

- the 6B23-2 modification features Class 4 protection. This higher level of protection is achieved through the use of a ceramic armor plate "Granite-4M" [3,4] placed in the chest section pocket. In this modification, the body armor can successfully withstand hits from armor-piercing ammunition fired from rifles or assault carbines, as well as armor-piercing bullets from a "Dragunov" sniper rifle.

Additionally, the back of the 6B23-2 is reinforced with a Kevlar protective screen [3]. There is also an option to enhance the back protection with a standard steel armor plate, which provides Class 3 protection.

1.2. Body armor 6B45

The 6B45 body armor is in service with the armed forces of the Russian Federation and is part of the "Ratnik" combat gear designed for infantry units. Introduced in 2014, it replaces the earlier 6B23 model. The body armor is manufactured by the "Techinkom" company in Saint Petersburg [5].

The inner part of the 6B45 body armor is made of Kevlar and features pockets for inserting additional armor plates at the front, back, and sides. The body armor also has a handle for dragging personnel in case of injury, which enhances its functionality and convenience in use.

The basic model of the 6B45 vest weighs 8 kg and includes additional protective elements such as a collar for shrapnel protection, side anti-fragmentation bags, front and back armor plates, a quick-release system, and a modern ventilation and shock absorption system. The level of protection of the vest is equivalent to GOST 5A, capable of withstanding hits from 7.62x39 mm armor-piercing incendiary bullets, and can be upgraded with "Granite" plates to offer protection up to class 6A [6]. The design allows for comfortable handling of weapons and head movement, thanks to the pronounced shoulder pads and adjustable collar.

The area of maximum armor protection is approximately 0.7 to 0.8 square meters for each section.

The modification (called the assault version) of the 6B45 body armor includes additional shoulder pads that provide anti-fragmentation protection, a set of ceramic armor plates with Class 4 protection (according to GOST 6 to 6a) for the chest, back, side parts, and the lower rows of the front and back of the body armor [6]. The weight of the body armor is 8 kg in the basic configuration, and up to 15 kg in the assault modification, depending on the added armor plates. Additionally, the set includes a buoyancy maintenance system for overcoming water obstacles.

The analysis shows that the 6B45 body armor provides a higher class of protection and significantly more comfort during use. An advantage in this case is the presence of the "MOLLE" system, which allows for the attachment of additional modular pockets and various compatible accessories to the body armor. Additionally, the area where the weapon rests during shooting is larger and higher than in the previous model, which allows for more comfortable positioning and thereby higher shooting accuracy. Another positive aspect of the body armor is the



Fig. 2. Body Armor 6B45.

collar configuration, which in this model does not hinder head movement and ensures comfortable wearing of the vest. A new feature of the 6B45 body armor is the quick-release system, designed to prevent drowning of personnel who fall into water bodies during the crossing of water obstacles, and the possibility to replace the armor plates.

The disadvantage of the 6B45 body armor is its smaller area of fragmentation protection in the standard configuration (which is significantly lower than that of the 6B23).

The general disadvantages of the body armors used by the Russian Federation are:

- significant weight, which reduces maneuverability, causes discomfort, and fatigue to personnel during combat actions;
- the configuration of the body armors includes non-removable pouches with embedded protective material packages. In this configuration, if the material gets wet, it loses its protective properties, which leads to the body armor being considered unusable and scrapped;
- the use of low-quality materials for manufacturing additional elements (such as fasteners, etc.) of the body armor, which leads to low durability and reduces the functionality of the body armor.

2. MEANS OF INDIVIDUAL BALLISTIC PROTECTION USED BY THE ARMED FORCES OF UKRAINE

The armed forces of Ukraine use various types of body armor, including domestically produced and imported models received as military aid. These vary from vests designed to protect against handgun bullets to modern tactical and modular vests capable of stopping bullets from ammunition used in automatic rifles and assault carbines.

2.1. Body Armor "Corsar M3M"

The Ukrainian company "Temp 3000" produces a range of ballistic protection products, one of which is the "Corsar M3M" body armor.

This modular tactical body armor combines multifunctionality and an ergonomic design with various equipment options. It includes internal pockets for soft and hard armor plates, covering protection levels from NIJ IIA to IV. The soft armor panels, made from "Twaron" type para-aramid fiber, similar to "Kevlar," are sealed in a waterproof case, while the pockets for hard plates accommodate plates sized 254x305 mm and 254x356 mm [8].



Fig. 3. Body Armor "Corsar M3M".

The "MOLLE" system allows for the attachment of additional modular pouches and various compatible accessories to the body armor.

"Corsar M3M" body armor is available in four modifications:

- the first modification includes protection at the front and back with a protective area varying from 37 to 44 dm², depending on the size of the body armor. The shoulder attachment system is adjustable and features reinforced fixation. Hard armor plates (level III – IV) can be added to the body armor for enhanced protection. The waist is fastened with buckles made from impact-resistant plastic, and the vest is designed with voluminous cushioning strips on the inner surface, which allow for continuous ventilation of body heat and quick evaporation of sweat [8];

- the second modification offers protection at the front, back, and sides with a protective area ranging from 49 to 62 dm², depending on the size of the body armor. This modification includes removable side panels that can be optionally detached, features quick and convenient side opening, and allows for the addition of hard armor plates as chosen [8];

- the third modification provides comprehensive coverage, including neck and groin protection with a protective area ranging from 61 to 76 dm², depending on the size of the vest. It includes removable ballistic protection for the throat and groin for added security;

- the fourth modification further extends protection and includes areas at the front, back, sides, neck, groin, and shoulders, offering a protective area between 70 to 86 dm², varying depending on the size of the vest. This modification introduces removable ballistic protection for the shoulders, further enhancing the wearer's safety against ballistic threats [8].

2.2. Body Armor "Pantsir-Raid"

The "Pantsir-Raid" body armor, produced by the Ukrainian company "Temp 3000," is designed to provide enhanced mobility and comfort. The body armor features internal pockets designed for soft armored panels, with protection levels ranging from IIA to IIIA. These panels are made from para-aramid or UHMWPE (Ultra-High Molecular Weight Polyethylene), ensuring both durability and light weight [9] [10]. To protect against moisture, the soft armor panels are sealed in a waterproof case. Additionally, the vest is equipped with internal pockets for hard armor plates, with protection levels of III or IV. These pockets are designed to accommodate hard armor plates measuring 254 x 305 mm and 254 x 356 mm. For increased functionality, the vest includes a "MOLLE" system on the



Fig. 4. Body Armor "Pantsir-Raid".

front and back, allowing for the attachment of various equipment and accessories. The outer shell of the vest is made from a blend of polyester and polyamide fabrics, providing both durability and comfort [9].

The "Pantsir-Raid" body armor is available in two modifications:

- the modification with hard armor plates provides protection at the front and back. The offered protective area varies between 15 and 18 dm², depending on the chosen size of the body armor. The design allows for adjustable straps and waist size. The vest is equipped with pockets for six automatic rifle magazines and additional side zip pockets. These side pockets also offer the option to be supplemented with hard armor plates. Additional storage space is provided through a document pocket and an identification panel located on the back of the vest. For comfort and reducing body heat, continuous ventilation is ensured by using 3D mesh fabric or voluminous strips on the inner surface of the vest;

- the modification with soft armor panels focuses on incorporating soft armor panels, with the option to add hard armor plates, all housed in internal pockets. This configuration also ensures protection at the front and back but with a larger protective area, varying from 27 to 30 dm², depending on the size of the vest.

Both modifications are designed to meet various operational requirements and personal preferences, providing both protection and functionality. In the second option, despite the larger protective area, the level of protection is lower due to the lower grade of the armor panels.

CONCLUSION

The analysis of ballistic protection means used by the armed forces of the Russian Federation and Ukraine highlights significant development and adaptation to the modern requirements of warfare. The Russian body armors 6B23, 6B43, and 6B45, introduced in different periods, represent an evolution in design and functionality, aiming to optimize protection and comfort for the soldier. Although the 6B23 is an older model and has been replaced by the newer 6B43 and 6B45, it continues to be used, demonstrating its reliability and effectiveness in combat conditions. The modernization with ceramic and steel armor plates in the new models enhances the protection class, allowing for greater flexibility and adaptability to various threats.

On the other hand, Ukrainian body armors like the "Corsar M3M" and "Pantsir-Raid" demonstrate a commitment to innovation in ballistic protection, featuring multiple modifications to optimize both protection and comfort. These vests are designed to meet diverse operational needs, offering a modular system and customization options that enhance the wearer's mobility and functionality. These features make them adaptable to varying battlefield scenarios, reflecting a modern approach to personal armor technology.

The comparison between the ballistic protection means of the two countries illustrates different approaches and priorities in the development of military

equipment. While Russian forces focus on consecutive enhancements and increasing protection with existing technologies, Ukraine seeks to integrate new materials and concepts to improve the efficiency and adaptability of its protective systems. Both countries emphasize the importance of the individual body armor as a critical component for soldier survival on the battlefield, continuing to develop and implement solutions that meet modern military challenges.

This ongoing evolution underscores a strategic commitment to safeguarding troops while adapting to the dynamic nature of contemporary warfare [12].

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