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# BALLISTIC PROTECTION SYSTEM FOR MILITARY HELICOPTERS

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**Abstract:** *This article presents the importance of military helicopters and the need to protect them with a ballistic protection system against terrestrial threats. Current ballistic protection systems are in a permanent development by optimizing materials and protective structures and discovering new materials, in order to balance the variety of threats in the theaters of operations and the protection against them. Critical helicopter areas and types of materials used in the development of current ballistic protection systems will be presented.*

**Keywords:** *military helicopters, ballistic protection, terrestrial threats.*

## 1. INTRODUCTION

The helicopter is one of the fastest way of transport in the world and, compared to the plane, has the advantage of being able to take off and land vertically, so the reaction time is much diminished. The use of helicopters, despite very high manufacturing costs, is justified by a number of advantages, as they can fly at fixed point, take off and land without a runway and are equipped with adaptable maneuverability specific to every situations.

Helicopters are characterized by versatility, mobility, flexibility but also vulnerability.

Also, the helicopter is an effective weapon during a war, but in this case, the requirements are significantly more important, as they must also be equipped with weapons. Military helicopters play a very important role in air, land and maritime operations. Generally, helicopter structures have been developed on different weight / size classes, which can be adapted to different roles by installing the equipment specific to each mission.

Among the most important missions of military helicopters we can note: search and rescue missions, observation missions, airfighting missions, airborne command and control missions, troop / material transport missions, and air assault and electronic warfare.

## 2. THREATS TO STRUCTURES OF MILITARY HELICOPTERS

An attack helicopter is an armed helicopter capable of attacking terrestrial targets such as enemy infantry, tanks, and armored vehicles. The weapons used on these helicopters may include guns, missiles, and anti-tank missiles. They are also capable of carrying air-to-air missiles for self-defense purposes.

The range of threats is represented by the airborne or terrestrial attack and / or research components or, more specifically, the ability of the opponent to detect, identify

and engage helicopters and can be classified into three levels of threat intensity as: low, medium and picked up.

During the fight, helicopters encounter various threats, including the following:

- air defense systems (individual infantry armaments, portable air rocket launchers and anti-aircraft artillery);
- the armament on the tanks, guided anti-tank missiles;
- terrestrial artillery;
- tactical enemy aircraft;
- armed enemy helicopters;
- electronic warfare systems;
- CBRN threats.

There are also survival countermeasures for helicopter crews, such as:

- flying at a low height;
- reducing exposure time;
- avoiding predictable action;
- securing communications;
- repositioning;
- ensuring CBRN protection;
- annihilation of Enemy Air Defenses (Suppression of Enemy Air Defences-SEAD);
- the use of air-to-air tactics in combat;
- "stand-off" combat procedures;
- aircraft survival equipment;
- BALLISTIC PROTECTION.

### **3. HELICOPTER BALLISTIC PROTECTION**

Helicopters are using a wide range of techniques, tactics, procedures and equipment to counter these types of threats, but, so far, none has proven they can guarantee full protection against them.

Flight at very low heights requires a strident flight below 50 meters to avoid detection and launches by specially designed systems for higher height targets. In the absence of these systems, helicopters can evolve at heights of 500 meters above the ground and avoid the impact of the most small arms.

Some helicopters have ballistic protection options by installing armor systems, but these are limited to protecting the crew and some parts of the helicopter that are vital to its operation. Apart from the fact that they greatly increase the mass of the helicopter by diminishing the number of patients and the members of the accompanying medical teams, ballistic protection systems also have the disadvantage of offering only a certain degree of protection against smaller firearms.

There are also more advanced or more sophisticated methods of active protection against radar or infrared threats, using warning and countermeasures such as “chaff and flare”.

Helicopters, like any other aircraft, have critical /sensitive areas, areas that, if were hit by anti-aircraft defense systems or even the infantry armament, can endanger the helicopter and the crew. Thus, the critical areas of the helicopter can be categorized into two categories:

- the power plant compartment and the mechanical assemblies;
- cockpit and cargo compartment.

The materials of the various construction elements are made mostly of light alloys for the resistance parts, titanium for thermally applied parts and plasticized plastics for parts that are not subject to special efforts.

Nowadays, in the modern war, in which armored vehicles have a wide use, we must note the ability of the bullet to perforate the armor and the factors which determine the depth of penetration into the obstacle are: the kinetic energy of the bullet, the weight, the shape and the construction of the bullet, the quality and thickness of the armor, the angle of incidence and the shooting distance.

Current ballistic protection systems are in constant development by optimizing protection materials and structures and by discovering new materials to strike a balance between the variety of threats and protection against them.

Practically, the history of armored technique is a history of projectile / armor competition. Although there have always been pieces of artillery, ammunition or mines capable of destroying armor and often it has been declared useless and obsolete, it has never been abandoned. Thus, armored vehicles remain the most effective weapons.

The concept of armored protection is defined as the capability of the military vehicle to withstand attacks executed with a variety of means: mines, grenades, projectiles, improvised explosive devices, weapons of mass destruction and to provide crew protection while executing missions.

Basically, armor is considered to be the set of plates designed to provide protection against bullets, enemy projectiles or their skirts.

Figure 1 illustrates the evolution of the armor over time, namely the revolutionary reduction of the areal density of the vehicle's armor, as developed by the protective materials, starting from the homogeneous laminated armor, BOL, and advancing to complex composite systems.

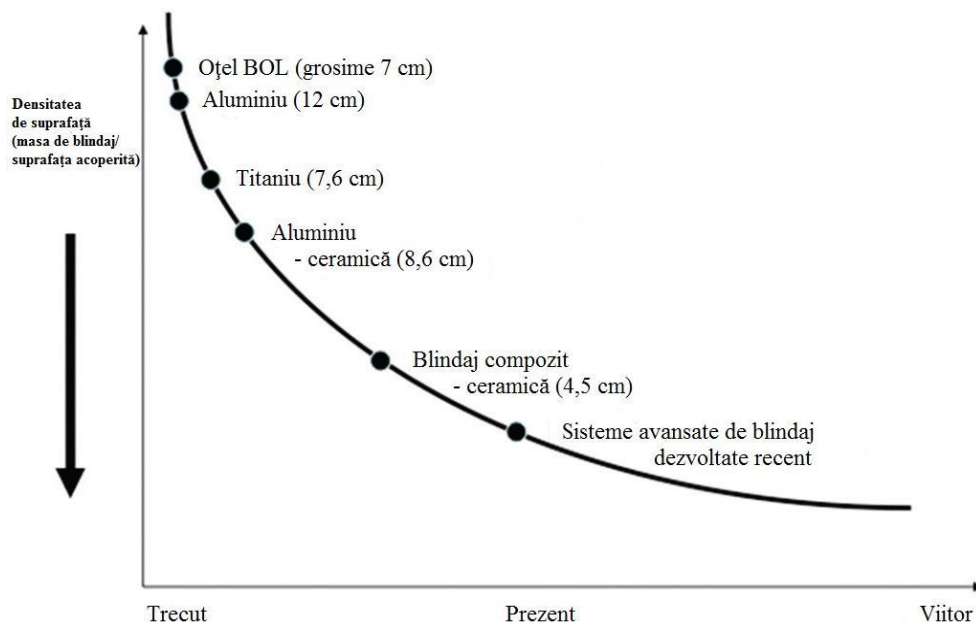


Fig. 4.1. Evolution of surface density of the armor over time

It can be concluded that new low-density materials such as titanium, aluminum and ceramics offer a higher level of protection with a smaller mass per unit area over time.

The curve highlights the fact that, in the future, it is intended to continue to obtain small surface densities, despite ever-growing ballistic threats.

During the evolution of the concept, armor protection has materialized in the following forms:

- total protection;
- global protection;
- differential protection;
- general protection.

#### **4. CONCLUSIONS**

Current solutions for ballistic protection are in continuous development, through ongoing research, by optimizing previous solutions and discovering new materials.

Thus, nowadays, ballistic protection systems that are installed on some military helicopters are modular plaque systems mounted in its critical areas that provide a level of protection for aircraft and crew during executing missions in theaters of operations.

The mass of the helicopter is an extremely important factor, especially during operations at high altitude, where engine performance decreases due to lack of oxygen. In order not to affect the flight configuration of the helicopter, first of all, ballistic protection systems must have a low mass. Therefore, composite materials are used in the manufacture of these armors, while offering reduced mass and increased protection.

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