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Ballistic threats on military helicopters

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Abstract. The importance of helicopters cannot be disputed, since they perform missions of transport, search and rescue, medical evacuation, and of course, air ground-support, being a real weapon, when are properly equipped. This article presents the ballistic threats on military helicopters, the risks that helicopters face, the threats that appears during the missions and protective measure. Also, critical and sensitive areas of the helicopters will be presented.

1. Introduction

Most helicopters are built for practical purposes, such as transporting the wounded to the hospital quickly, so that their chances of survival increase. They can also be charged with water to help put out large fires. Another intense use of them is “Search and rescue”, where helicopters are sent to the mountains, lakes/seas or other places hard to reach to perform search and rescue missions.

In addition to the humanitarian purposes mentioned above, the helicopter could be an effective weapon, when is properly equipped for each mission.

Under the conditions of the actual confrontation space, helicopters may face asymmetrical threats during missions, fights between armed groups or technologically advanced elements from the conventional adversary's air defense system or lack of systems navigation from the ground.

In recent conflicts, grenade attacks propelled by unmanned reactive projectiles and small-arms fire on helicopters have claimed many lives. In response, it has begun the development of packages for the self-protection of helicopters, as well as for the detection of the threats. Also, has started the development of means to counter threats against these aircraft,

It is interesting how technical means, such as airbags and bulletproof seats, as well as materials and layers resistant to undirected reactive projectiles, wich was originally intended for the protection of armored vehicle personnel, can be now incorporated into the construction of current helicopters [2].

2. The risks that helicopters face

The main risks that helicopters are exposed may be:

- Flight under reduced visibility caused by: phenomena such as dust cloud, snow cloud, low residual light or excessive light intensity, heavy rainfall, high obstacle degree, obscuration weather phenomena (hydrometeors / fog, snow or litometers, dust, mud, industrial smoke, volcanic ash), the shape or cover of the land;
- flight in special climatic conditions - corrosive atmosphere, atmosphere loaded with dust and sand, with abrasive effect on the moving elements relative to the air;
- errors in navigation instruments or insufficient navigation data;
- extreme outside temperatures with effects on crew and aircraft performance;
- lack of ground equipment corresponding to navigation and precision systems;

- loss of radio connection with the base or other aircraft participating in the mission and recognition of the position of other aircraft participating in the mission.

3. Threats to helicopters and protection methods

Depending on the level of threat intensity, three categories can be stated:

- *Low level of threats* - is the one characterized by a very dispersed and superficially concentrated presence of enemy forces and their ability to re/organize is limited. The weapons systems that can be found in this type of environment are: small infantry weapons, small artillery elements with a caliber up to 14.5 mm or equivalent, grenade launchers and portable infrared missiles (SAM). The tactics, techniques and procedures used by helicopters and helicopter formations do not normally require extensive planning and preparation before take-off, and the security environment allows operation, limited to passive protection countermeasures, to avoid exposure to detection and employment.

- *Medium level of threats* - is the spectrum characterized by an increased presence of the opponent's forces, concentration and their weapons, requiring both active and passive measures to avoid or reduce threats and prevent engagement. The weapons systems that can be found here are systems with low destructive power, advanced generations of SAM. The helicopter unit engaged in such an environment is required to carry out consistent planning and to be prepared for threat avoidance procedures, evasive measures, to be equipped with countermeasures, to have jamming protection, to be equipped for electronic warfare and / or use aircraft for direct protection.

- *High level of threats* - is the spectrum in which hostile forces are found on large areas in the area of operations, with high density and degree of concentration and capable of immediate organization and mobilization. The weapon systems used by these forces include state-of-the-art SAM systems, modern mobile ground radars, early warning systems, electronic countermeasures and integrated anti-aircraft defense capabilities. This spectrum is also characterized by fully integrated air defense systems, command and control networks and advanced electronic warfare capabilities. Enemy ground systems can be heavily armored and very difficult to destroy / neutralize. Operating in such an environment requires planning down to the smallest detail of actions and dedicated force packages that are able to neutralize or destroy enemy weapons systems before proceeding with the helicopter mission.

The types of ground threats, analyzed from the point of view of helicopter specificity, can be divided into two main categories, as follows:

- guided weapon systems;
- unguided weapon systems.

Guided weapon systems used against helicopters can also be divided into three categories, as follows:

- those who use radars to be assisted in the acquisition of the target;
- those that use infrared radiation in the acquisition of the target;
- those that use combinations between the two solutions.

Radar-guided weapon systems do not provide solutions for directing explosive charge once it has been launched, this capability being specific to missile systems. All types of radar-guided weapon systems are very difficult to mask and they operate on the battlefield because they are generally characterized by large dimensions and are powerful emitters of electromagnetic radiation, so they can be discovered and targeted as soon as are put into operation.

Infrared radiation weapon systems have been used as independent systems of any power supply in the personal equipment of the military. Also, these weapons have a small size and are easy to hide, making them almost impossible to detect before launch. These systems have been specially developed and adapted to fight against helicopters in combat. Their range varies significantly, most of them being able to hit helicopters almost on their entire flight area, excepting flight at very low altitude.

Unguided weapon systems require a trained operator to discover, track, launch and aim the mobile targets. This category includes weapons, from assault rifles to large-caliber, anti-aircraft artillery elements, as well as unguided projectiles or guided missiles used in an unguided manner.

These systems can be very difficult to detect before launching, but due to the fact that they are not provided with steering systems, the probability of hitting the helicopter them is low.

The situation in which is encountered a mixed anti-aircraft system, consisting of directed and non-directed weapons is the worst case scenario for a helicopter.

Since the guided weapon systems have a high accuracy and hitting power and being much more effective against high-altitude targets, they force helicopters to evolve at low altitudes, making them exposed against unguided weapon systems.

Helicopters can also use the maneuvering procedure to decrease the effect of threatening weapon systems. As threats have developed so much in recent years, they already have the potential to counter this type of procedure. Moreover, the transport of patients in the context of using such a procedure can have irreversible effects on their health.

In order to respond to the threats of the current field of operations, the protection systems and the constructive solutions of the platform, the following principles must be respected:

- the main purpose of the attack helicopter protection system is to avoid its detection by the enemy;
- if the helicopter is unable to avoid detection, the next goal is to avoid the helicopter being identified by specialized enemy systems;
- if the helicopter is unable to avoid identification, the next goal is to avoid the impact of the blow fired by the enemy's air defense systems;
- if the helicopter is in a situation where it cannot avoid the impact with the shot launched on it, the immediate goal is to limit the impact of the impact with the shot.

Regardless of the number of systems or how developed are these protection systems used by the latest generation helicopters and, no matter how significant their contribution on the battlefield, given that their practical field of use is close to the ground, their vulnerability cannot be completely eliminated.

4. Helicopters critical areas

Of course, like any other aircraft, helicopters have critical and sensitive areas that if would be hit by air defense systems or by individual infantry armament, the helicopter and crew may be endangered. This sensitive areas of the helicopter can be classified into two categories:

- compartment of the power installation (two TURMO IV CA engines) and the mechanical assemblies, as shown in figure 1;
- pilot's cabin and cargo compartment, as shown in figure 2.

Constructive elements are made of light alloys for resistance parts, titanium for thermally demanded parts and starter plastics for parts that are not subjected to special stresses. In addition, certain areas, which must be both light and rigid, are “honeycomb” type construction [3].

The panels, hoods and fairings, which are fixed to the mechanical floor, on the tail beam and on the pillar, protect various mechanical, transmission and service members, placed on the outer structure of the fuselage [6] .

The power plant comprises two TURMO IV CA engines of gas generator type with free turbine, located, above the cab (cargo compartment), connected directly to the main transmission box [5].

Mechanical assemblies include:

- main rotor hub;
- main gearbox;
- transmission shafts;
- intermediate transmission box;
- the rear gearbox.

The mechanical assemblies are driven by the power installation, together giving the helicopter sustentation force.

This compartment of the power plant and mechanical assemblies is a critical and essential area of the helicopter. If this area would, the helicopter and crew would be in danger of crashing.

The second critical area of the helicopter is the cockpit and the cargo compartment (figure 2). Unlike the compartment of the power plant and mechanical assemblies, these areas, if would be hit by projectiles, can directly affect the crew and passengers.

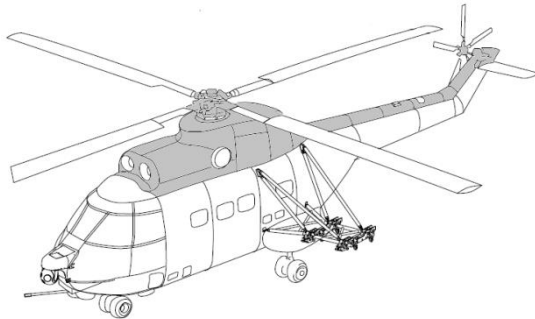


Figure 1. Compartment of the power installation and of the mechanical assemblies

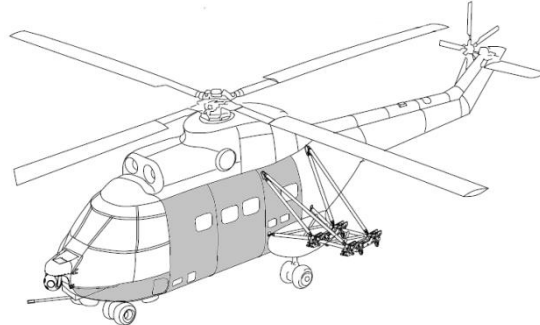


Figure 2. Pilot's cabin and cargo compartment

In order to protect, first of all, the passenger, ballistic systems have been developed. These ballistic protection systems are made of plates of composite materials, of small dimensions, just to change easily and to cover a large surface, able to withstand multiple hits at large calibers.

5. Conclusions

The importance of helicopters cannot be disputed, since they perform missions of transport, search and rescue, medical evacuation, and of course, air ground-support, being a real weapon, when are properly equipped.

Durring the missions, helicopters are exposed to differents threats. Depending on the level of threat intensity, three categories can be stated: low level, medium level and high level of threats. Also, analyzed from the point of view of helicopter specificity, there are two types of ground threats, guided weapon and unguided weapons systems. Given the threats to which helicopters are exposed, over the time, preventive measures have also been taken against them.

Currently, in the field of armored equipment, protection is defined as the set of constructive and tactical measures aimed at avoiding the discovery of the technique by the enemy, avoiding its impact by mobility or active means of hiding and defense and, finally, its survival after hitting by enemy forces.

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