

Aviation Precision Weapons: Logical-Epistemological Aspect

Mamanazarov Rahmadjon Ahmadjonovich

Major, Senior Lecture Department of Aviation Weapons Institute of Military Aviation Republic of
Uzbekistan

Annotation:

The article presents an approach to the concept of «high-precision aviation weapons», the composition of the concepts used by researchers in defining the concept of «high-precision weapons». Technical and tactical features of high accuracy are revealed. Classification features of the method of applying an air strike are proposed. The methods of organizing the use of high-precision aviation weapons are given.

Keywords: *high-precision weapons, scope and content of the concept, features of high-precision, methods of organizing the use of aviation high-precision weapons.*

Introduction. It is known that the basis of all technology and weapons is science, moreover, technology and weapons are science itself. Thus, the course and outcome of modern armed struggle in war have become increasingly dependent on scientific achievements and the potential capabilities of the state in the field of technology and weapons. Both the creation and modernization of aviation weapons are the result of the process of evolution of types of aviation weapons. Evolutionary transformations of aviation weapons (as a technical system) follow the path of adaptation to the conditions of aviation combat operations (conditions for the functioning of aviation weapons). It should be noted that from a systemic point of view, a technical system, which is an aviation precision weapon, cannot exist in these conditions if it (it is an aviation precision weapon) is not adapted to these conditions. Otherwise, such systems are doomed to disappear. In the creation and modernization of aviation precision weapons, general progress (systemic progress) and private progress are distinguished

Relevance. General or systemic progress is achieved on the basis of a transition to new, more effective principles of the general design of an aircraft weapon system, to optimization of the main parameters of these weapons and aircraft weapons (energy, reliability, weight, accuracy, etc.), to the creation of redundant structures, increasing the efficiency and reliability of aircraft weapons.

General progress is complemented by information and energy progress. Information criteria for progress characterize the progress of aircraft weapons systems in terms of accumulating information about the conditions of aviation combat operations, and energy criteria show the degree of efficiency and economy of the aircraft weapons system. General progress is characterized by the emergence of such structural and functional changes that lead to the improvement of the aircraft weapon system itself. Progress is carried out in this case by improving not only individual elements and parts of the aircraft weapon system, but also the weapon system as a whole. As a rule, the general progress of aviation precision weapons was accompanied by a constant complication of the system of these weapons. In contrast to systemic or general progress, private progress is achieved by improving individual elements or parts of aviation precision weapons. And as experience shows, private progress occurred more often. Particular progress has made it possible to adapt evolutionarily modernized aircraft weapons systems to the new conditions of aviation combat operations.

In contrast to the private progress of aviation weapons, narrow specialization represents the development of individual types of weapons that are highly specialized in nature. Given the narrow specialization of aircraft weapons and means of destruction, the transformation was limited and affected only individual parts of aircraft weapons or means of destruction. At the same time, the modernization of some parts of weapons or weapons was accompanied by changes or even the disappearance of others. An example of narrow specialization is aviation precision weapons, adapted to solve limited functions (special combat missions).

Turning to the issue of the emergence of prerequisites for the creation of aviation precision weapons, one should focus on trends in the modernization of equipment and weapons. The results of the analysis allow us to conclude that two main trends dominate in the modernization of equipment and weapons: the trend of increasing the degree of dynamism and the trend of transition to a supersystem. The tendency to increase the degree of dynamism manifests itself in the evolutionary process. In this sense, the modernization of aviation high-precision weapons is associated with increasing the accuracy of the use of weapons, increasing the effectiveness of the lethal effect of combat units, expanding the capabilities of weapons and the degree of their implementation in the increasingly complex conditions of combat operations of strike aircraft. The trend of transition to a supersystem highlights the main thing in improving aviation high-precision weapons and is manifested not in the creation of individual models of aviation weapons and sighting systems, but in systems of high-precision weapons. At the same time, the degree of implementation of the capabilities of a high-precision weapon system to destroy enemy targets increases significantly, especially if it is synthesized with reconnaissance and information subsystems.

The approach described above in practice is associated with the evolution of views on air destruction of enemy ground and sea targets, which dates back to the First World War. The lack of accuracy in the use of aviation weapons has led to the problem of the effectiveness of destruction of enemy ground and sea targets. In turn, tactics made demands on the improvement of means and systems for solving the aiming problem, as well as ballistic support for aircraft weapons. However, it was impossible to avoid mistakes and mistakes; the best that could be done was to reduce them to a minimum. To ensure high accuracy in the use of aircraft weapons, it is necessary that, firstly, the algorithm for solving the problem of aiming with an aircraft sight is fully and accurately described. Secondly, the initial parameters must be determined and taken into account when solving the aiming problem absolutely accurately. Thirdly, the algorithm for solving the aiming problem in the computer must be implemented without errors. Fourthly, the crew must carry out all operations on the combat route without errors. In fact, when using unguided aircraft weapons at the end of the twentieth century, none of the above conditions could be met. Solving the problem of high

efficiency of fire destruction of enemy ground and sea targets when using unguided weapons through extensification is possible only by increasing the number of aircraft weapons (bombs) in a salvo or series. Intensification of fire destruction of enemy targets is possible through the use of aviation weapons with high accuracy of hitting the target. At the same time, it turned out to be possible to intensify the fire destruction of enemy targets in two ways: by developing controlled aircraft weapons, the flight trajectory of which could be adjusted discretely or continuously (quasi-continuously) after being dropped from a carrier aircraft; improvement of ballistic support for solving the aiming problem during bombing with unguided bombs, i.e. modernization of the targeting and navigation system of the carrier aircraft.

It is known that since 1925, in Germany, the USSR and other economically developed countries, scientific research and development work on the creation of new weapons, including guided aircraft weapons, have been resumed in great secrecy. The successes achieved in radio electronics, communications technology, radio control, and navigation of aircraft in the 30s of the twentieth century made it possible to create unmanned vehicles with a range of impact on the enemy of several hundred kilometers. The creation in 1933, first in the USSR, then in Germany (in 1934), of a pulsating air-breathing engine was a prerequisite for expanding the capabilities of using guided weapons and significantly reducing the cost of their design. In the mid-1930s in Germany, the USA, the USSR and Great Britain, efforts were focused on research and experimental development in the field of radar. The main attention at that time was paid to the creation of air defense radar systems, although at the same time research was carried out on the possibility of using radar on board an aircraft. It should be noted that during these years, research was also carried out and systems and means were developed to determine the location of air targets by their infrared radiation and the sound produced. Thus, by the beginning of World War II, the prerequisites had been created for the development of aviation precision weapons. The main ones of these prerequisites include:

1. Since the birth of aviation, schools of aerodynamics have been formed. The level of research into the aerodynamics of aircraft carried out at research institutes and flight test centers in the leading countries of the world has made it possible to create and develop a methodology for studying and determining the aerodynamic characteristics of unmanned aerial vehicles.
2. The foundations of guidance and control systems for technical objects were laid, engineering methods for their design were developed, which made it possible to create stabilization systems and build autopilots for unmanned aerial vehicles
3. Advances in various fields of radio engineering, communications, and radio electronics have made it possible to design systems for correcting the flight path of unmanned aerial vehicles in acceptable dimensions and weights for placement on board unmanned aerial vehicles.

As noted above, to solve the problem of hitting the target accurately, two trends were observed, which were reflected in the concepts of the concept of “high-precision weapons.”

Currently, a number of publications have a sufficient number of definitions of “high-precision weapons”. Based on the results of this analysis, six groups of characteristic features are identified (Figure 1), which guided the authors when defining the concept of “high-precision weapons” [1].

It is known that a concept has four sides, which include sign, idea, content and volume. The main aspect of any concept, but not the only one, is a sign that unites an object or a group of similar objects with the thought of this object. The sign structures the thought itself, giving it integrity, a complete appearance and highlighting certain parts in it. The sign includes this thought in the semantic field, a space filled with related signs, which facilitates the comparison of thoughts in the form of judgments and inferences. In any concept there is an integral spiritual element, which has long been designated by the term “idea” (appearance, form, face, appearance).

An idea is a specific difference between an object or a group of objects from others, something that unites them and allows them to be denoted by the same word or sign. The idea, being the second side of the concept, intuitively arises every time we see a familiar object and call it a certain word or group of words. An idea is a visual image in a person's brain that precedes all his actions and is therefore the "beginning".

The content of a concept is a set of essential features of an object, which is conceived in a given concept. The content of a concept is a set of qualities, structural properties and relationships inherent in the object that is denoted by a given word, sign, or concept.

The scope of a concept is the set of objects that is conceived in the concept. Essentially, the scope of a concept covers the number of similar objects that can be designated by a given concept. The concept also has an addition to the volume, i.e. the totality of all objects that do not have a given concept. The connection between a concept and the scope of a concept is illustrated by the famous "Euler circle" [2].

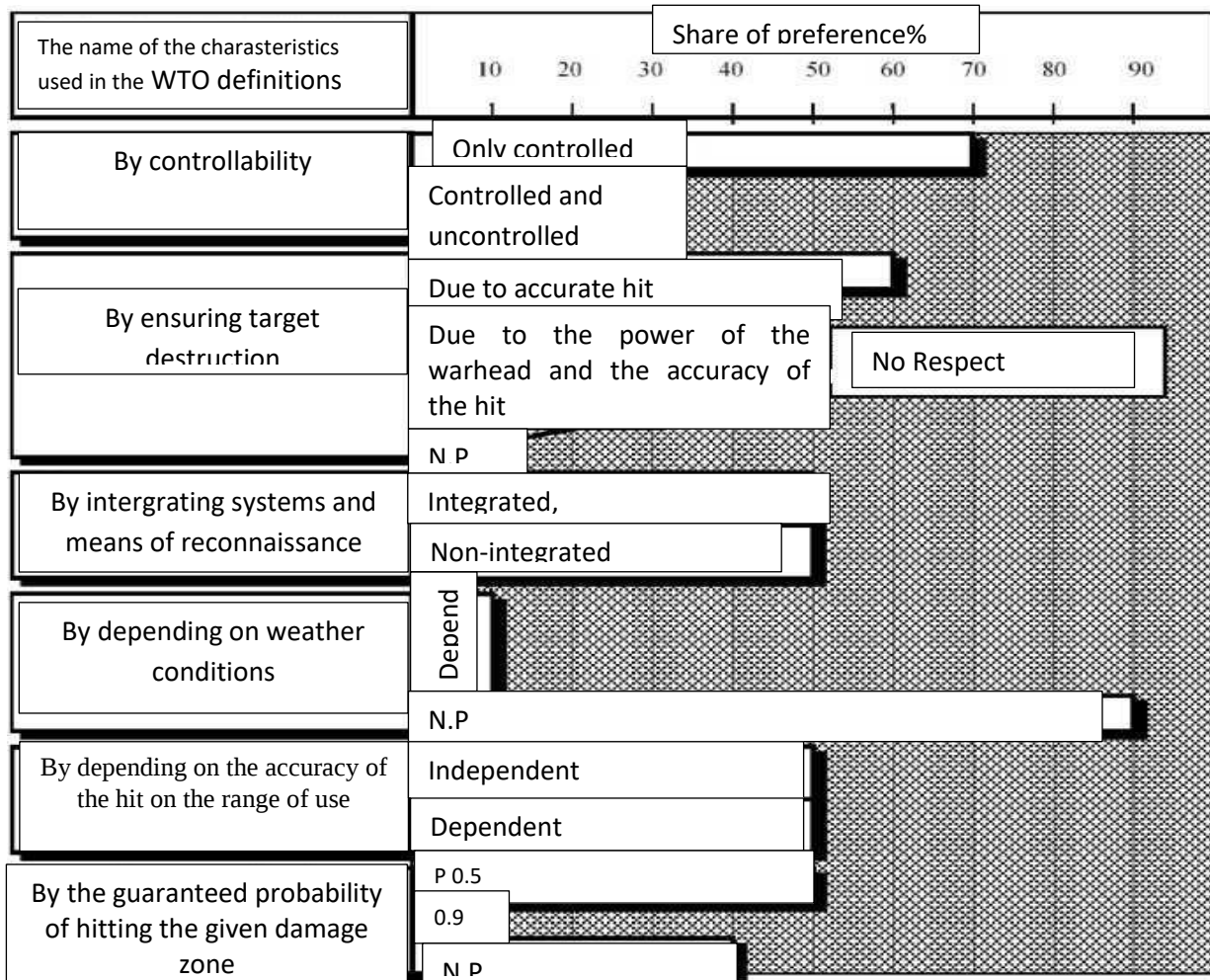


Figure 1. Composition of ideas used by researchers when defining the concept of "precision weapon"

If a concept is a four-way relation, then its structure is depicted using an iconic sign: a square, shown in Figure 2. Like the sides and corners of a square, the sides of a concept are connected in pairs by relations of identity and opposition. The equality of all sides and angles of the figure indicates the equality and mutual substitutability of sign, idea, content and volume.

The content and scope of a concept are related by relations of inverse proportionality: the richer the content of the concept, the smaller its volume, and the larger the scope of the concept, the poorer its content. For example, the concept of “weapon” has an indefinitely large scope, since such a term can designate any object that represents a means of defeating the enemy in an armed struggle. The entire set includes conventional weapons, weapons of mass destruction, precision weapons, weapons based on new physical principles, etc.

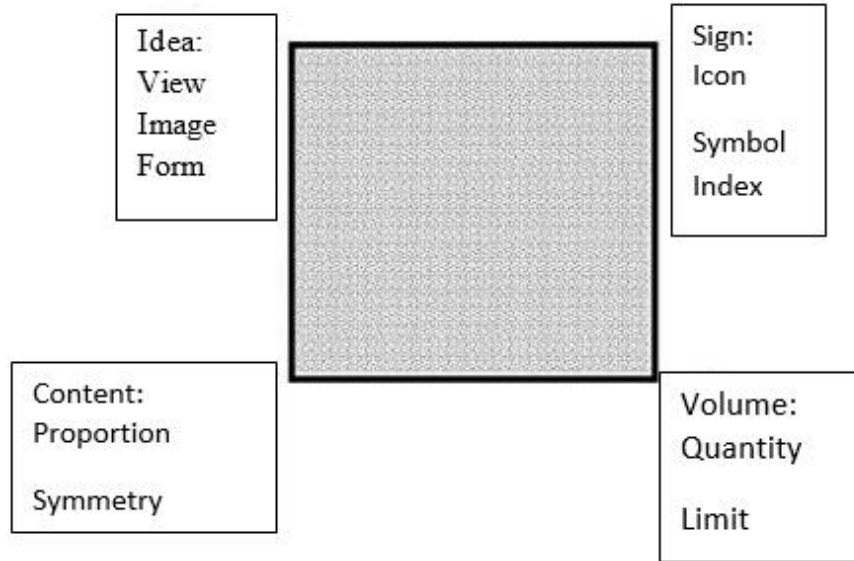


Figure 2. Sides of the concept

In this example, the scope of the concept “weapon” is maximum, and the content of the concept is minimum, since one single property of a weapon is the ability to kill (Figure 3).

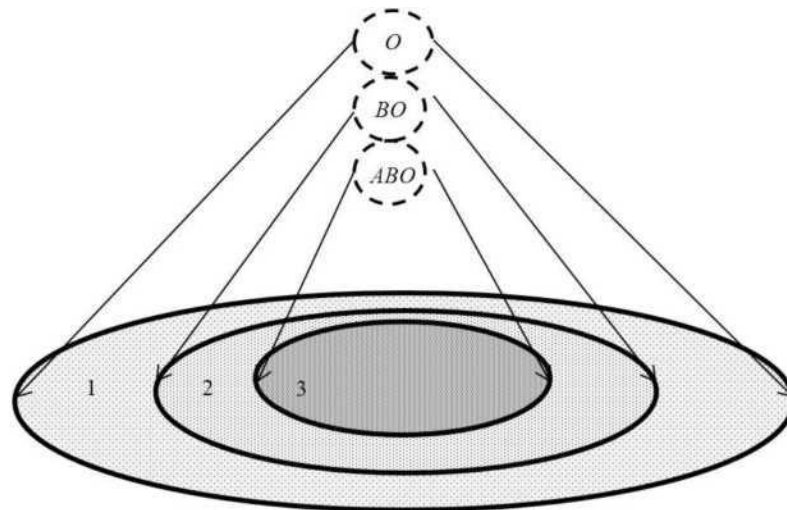


Figure 3. Relationships between the content and scope of a concept

Let's take another, similar concept: “high-precision weapons.” It has a smaller scope than the concept of “weapon”, since high-precision weapons are not only any object that represents a means of defeating the enemy in an armed struggle, but also an element of the scope of the concept “weapon”. This element is similar to the object it represents. Here, an essential quality is added to the ability to hit - “high-precision hitting the enemy.” The content has become richer, more extensive, and the volume has become smaller. And one more concept: “aviation precision

weapons.” This concept has an even smaller scope and even richer content, since a variety of means of defeating the enemy has been added to the initial possibility of destruction and essential quality.

In Figure 3: 1, 2, 3 - respectively, the volumes of the concepts O (weapons), high-precision weapons (HP) and aviation high-precision weapons (APW); the content of the concept ABO is greater than the content of the concept VO (in the sense that the concept ABO, in addition to the attributes B and O included in the concept VO, contains the attribute A), and the content of the concept VO is greater than the content of the concept O.

The concept of “aviation precision weapons” is relatively complex. An analysis of the definitions of “high-precision weapons” (HPE) used by various authors in educational and scientific publications showed that by this concept some authors mean ammunition, others - guided and unguided weapons, others - strike aircraft or reconnaissance-strike complexes, and etc.

The concept of “aviation weapons” is essentially associated with the aviation complex, and the concept of “aviation precision weapons”, for example for strike aircraft, will be expressed as an aviation missile-bomber complex (ARBC) or (in the future) an aviation reconnaissance-strike missile-bomber system. In this case, a specific feature of an aviation high-precision weapon will be associated and coordinated with the tasks of aviation (fire) destruction of the enemy, and the choice of an essential feature will be with the main feature of a high-precision weapon - accuracy as the degree of correspondence of the possible position of the point of impact of the weapon to a given position.

Thus, by high-precision aviation weapons of strike aviation we should understand those weapons that provide a high probability of hitting ground and sea targets not due to the power of the warhead of the aircraft weapons used (or the number of aircraft weapons in a salvo or series), but due to high accuracy their hitting the target (given affected area).

The effectiveness of the use of weapons is assessed using generalized characteristics of the damaging effect: the reduced damage zone (LEZ) - S_n , which has the following properties: when a weapon hits it, the target is hit reliably (probability of hitting the target $W_n = 1$), when using another weapon, it changes and the PPP itself. The magnitude of the PZP is not equal to the target area and depends on the conditions of use of the weapons. Thus, the given affected area is simultaneously a characteristic of the target, the weapon and the conditions of its use, and the probability of hitting the target is equal to the probability of the weapon hitting the PZP.

High-precision weapons (due to high accuracy of hitting the target) are used to hit targets with relatively small sizes. To assess the accuracy of using HTO, the value of the probable radial deviation is used. The law of dispersion of ASP is considered to be normal, since the dispersion of each weapon is determined by the total influence of many factors and at the same time the condition of the central limit theorem is satisfied. If we assume that dispersion occurs on a plane within the reduced dispersion area (SSA), the shape of which is assumed to be a circle with radius R_p and the SSA is covered by the SSA, then the geometric meaning of the probability of hitting a target will be expressed by the ratio of these areas, i.e. $W_{\pi} = \min \{1; S_p / S_p\}$, where S_p is the area of the reduced zone (area) of the lesion; S_p is the area of the reduced scattering area.

The numerical value of this probability will be a characteristic of the effectiveness of the combat use of ASP (aircraft weapons). Ensuring high efficiency not by increasing the energy power of the warhead and the number of ASPs used, but by increasing the accuracy of their hitting the target is the essence of the technical feature of aviation high-precision weapons. In the established dependence of the probability of hits of a weapon on the coefficient for the radius of the circle describing the zone of permissible deviations of the hit points (the limits of high hit accuracy), a guarantee probability close to 0.95 was accepted. In this case, the relative radius of the reduced target engagement zone is equal to two (Figure 4).

Therefore, by technical definition, aviation precision weapons of strike aviation mean an aviation missile and bomber complex designed to destroy enemy ground and sea targets with a probability of at least 0.95 in range conditions.

The range of combat use of high-tech weapons is one of the main controllable parameters of an air strike. An increase in the range of application of anti-aircraft guns, as a rule, led to a decrease in the accuracy of hitting the target. However, the tactics quite naturally imposed requirements on the aircraft weapons used: the range of use of the ASP should exclude the entry of an aircraft missile-bomber complex into the zone of destruction of air defense facilities; An increase in the range of application of ASP should not conflict with the accuracy of their hitting the target. In other words, it is necessary to have a so-called tactical sign of high-precision weapons.

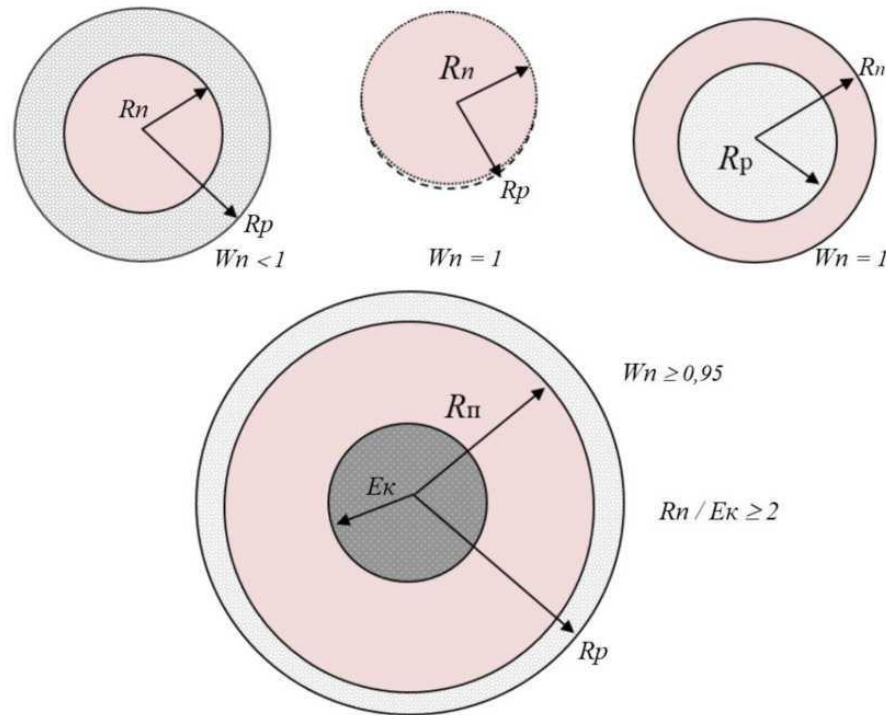


Figure 4. Technical feature of precision weapons

This feature is associated with the range of use of the weapon, which, in turn, affects the accuracy of the weapon's hit. If in the coordinate system "range of use - hit accuracy" we consider the conditional area for the dependence of the range of use of the weapon on the accuracy of the ASP hitting the target, then it is possible to establish a tactical sign of the high-precision weapon. With respect to this attribute, an increase in the range of use of a weapon should not affect the accuracy of hitting the given kill zone or the probability of hitting the target. Thus, on a tactical basis, high-precision strike aviation weapons include aircraft missile and bomber systems capable of using aircraft weapons outside the zone of the target air defense fire system and hitting ground (sea) targets with a probability of at least 0.95.

Summarizing the approach discussed above, it can be noted that such weapons should include ARBCs capable of using guided aircraft missiles and guided aircraft bombs with television-command, correlation-extreme correction systems and homing systems. Modern attack aviation ARBCs are equipped with systems and means to solve the problem of aiming based on target designation data or autonomously when performing complex types of maneuver in the target area. They are capable of hitting ground and sea targets using both guided and unguided aircraft weapons with a probability of at least 0.95. Such high-precision weapons of strike aircraft include, for example, the modernized ARBC Su-24M (SVP-24) and Tu-22M3 (SVP-22), Su-34, Tu-160.

Complex types of ARBC maneuver in the target area have virtually no effect on the accuracy of solving the aiming problem during bombing, and controlled ASPs are used outside the affected areas of air defense systems. These factors have a significant impact on increasing the ability to overcome countermeasures of target air defense systems and make it possible to increase the degree of implementation of capabilities to defeat enemy ground and sea targets.

The results of the analysis of the organization of air strikes using high-precision weapons based on the experience of military conflicts of the second half of the twentieth century. showed that each combat mission must have a corresponding method that resolves contradictions within the tactical situation. A tactical situation is an initially formulated combat mission that involves finding a way to resolve an organizational or tactical contradiction. When using high-precision weapons, the tactical situation determines the methods associated with the intensification of fire destruction of the enemy. Such methods, depending on the classification attribute of the method of delivering an air strike, are shown in table 1.

A selective method of organizing an air strike involves the simultaneous or sequential use of high-precision anti-aircraft missiles from one or several ARBCs against a vulnerable element of the target system.

Table 1

Classification attribute of the method of delivering an air striker	Name of the method of organizing an air strike using high-precision weapons
The nature of the organization of the use of precision weapons	Selective Concentrated Selectively focused
Required number of high-precision anti-aircraft weapons used to destroy an objekt	Single high-precision strike Group high-precision strike Massive air strike
Range of use of high-precision anti-aircraft missiles	Short-range air strike Long-range air strike

The essence of the concentrated method is to organize the simultaneous use of high-precision ASP throughout the strike target system as a whole. With this method of delivering an air strike, a high density of fire destruction of the enemy is achieved. The selectively concentrated method of delivering an air strike involves the simultaneous or sequential use of high-precision anti-aircraft weapons against targets from the system of the strike target. In this case, the aiming task is solved for any target from the strike target system. This method of organizing an air strike can be used against air defense system facilities in the presence of distracting radiation sources. A subsystem of methods for delivering an air strike is a set of methods for using high-precision anti-aircraft weapons on a target.

Conclusions

Thus, the emergence of aviation precision weapons and the experience of their use in wars and armed conflicts of the second half of the twentieth century. and military conflicts of recent decades - a factor that influenced the transition from extensification to intensification of fire destruction of the enemy. The transition to intensifying the fire destruction of the enemy has determined the relevance of the scientific problem, the essence of which is to develop, on a new methodological basis, the theory of organizing the fire destruction of the enemy by strike aircraft using high-precision weapons.

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