

METHODOLOGICAL GUIDE

DETECTION AND COUNTERMEASURES AGAINST UAVs



1st edition

August 2025

FOREWORD

This methodological guide summarizes the theoretical and practical experience of using unmanned aerial systems (UAS) and methods of countering them, accumulated during modern combat operations from February 2022 to August 2025. The information is current as of August 2025 and reflects the state of knowledge and practices during that period. The field of UAVs is developing extremely rapidly. Tactics, technical solutions, and system characteristics become obsolete literally every month. In such a dynamic environment, individual data or recommendations may become irrelevant or contain inaccuracies by the time you read them. The material was originally created for lectures and contains illustrations and comments that make it accessible to a wide audience. This work does not claim to be an exhaustive and eternally relevant guide. Its purpose is to serve as a practical introduction to the key aspects of the topic:

1. The diversity of UAVs: capabilities and limitations.
2. Basic tactics for the combat use of UAVs (reconnaissance, strike, mining, electronic warfare).
3. Classification and features of the use of various types of ammunition for UAVs.
4. Principles and methods of multispectral camouflage (personnel, equipment, positions).
5. Organization of UAV detection (visual, technical means).
6. Modern means and tactics for actively countering UAVs (electronic warfare, small arms, air defense).

The author apologizes for any inaccuracies or inconsistencies caused by the rapid changes in this field described above and the subjectivity/limitations of personal experience. This material has been prepared by a private individual on his own initiative.

The manual is intended for instructors, unit commanders, and personnel, providing them with only a basic foundation for understanding the threat of UAVs and methods of defense, which must be continuously supplemented with the latest operational data, guidance, and practical experience.

V.P. Veshnev, Moscow, August 2025.

The use of UAVs in combat conditions:

- Conducting aerial reconnaissance
- Fire correction
- Striking enemy personnel and equipment
- Aerial (remote) mining/demining
- Strikes on transport and fuel and energy infrastructure facilities, crossings, command posts, etc.
- Control of the use of weapons/support of assault groups
- Signal suppression/amplification, technical reconnaissance
- Provocative/deceptive actions

Author's comment: initially, this material was prepared solely for illustrative purposes, where the instructor/lecturer, depending on the tasks/group, could dwell on any aspect in more detail

Types and classes of UAVs

CLASSIFICATION BY TYPE OF CONSTRUCTION

The following types of UAVs are distinguished, differing in design and principle of operation, takeoff/landing, and purpose:

Multirotor UAVs



Aircraft-type UAVs



Helicopter-type UAVs



Unmanned tiltrotors and hybrid models



Aerostat-type UAVs
Aerostatic-type

Types and classes of UAVs

Fixed-wing UAV

Advantages

- Flight range
- Flight Altitude

Disadvantages:

- Runway
- Constant mobility



UAV "MQ-9 Reaper"

DISADVANTAGES AND ADVANTAGES

MULTICOPTERS

Advantages:

- Mobility
- Absence Runway

Disadvantages:

- Smaller radius of action
- High energy consumption



DJI MAVIC AIR-2 UAV

Types and classes of UAVs

Aircraft-type UAV

Fixed-wing UAVs are capable of flying thanks to the lift generated by the aerodynamic shape of the wing when moving forward at a certain speed, which is achieved in various ways. They are used for reconnaissance, surveillance, and striking ground and air targets.



A1-S "Furia" UAV (Ukraine)
(reconnaissance)



Leleka-100 UAV (Ukraine)
(reconnaissance)

Types and classes of UAVs

RUSSIAN UNIVERSAL CLASSIFICATION

- Micro and mini short-range UAVs (takeoff weight up to 5 kg, range up to 25–40 km)
- Light short-range UAVs (takeoff weight 5–50 kg, range 10–70 km)



Chernika-2 UAV
(kamikaze)



Eleron-3 UAV (reconnaissance)

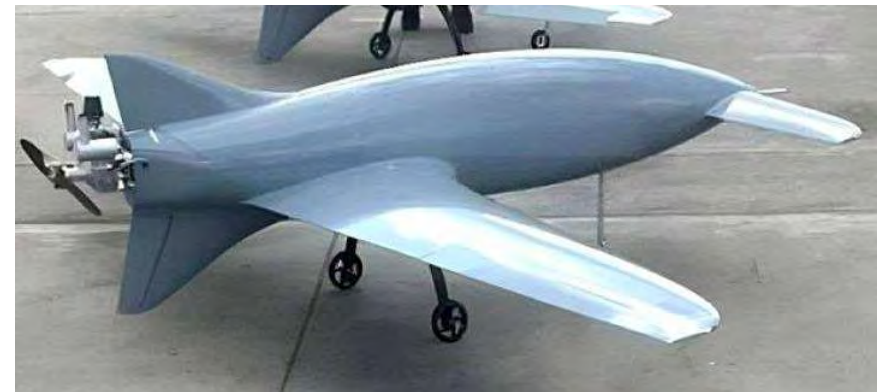
Types and classes of UAVs

RUSSIAN UNIVERSAL CLASSIFICATION

- Light medium-range UAVs (takeoff weight 50–100 kg, range 70–150 (250) km)
- Medium UAVs (takeoff weight 100–300 kg, range 150–1000 km)
- Medium-heavy UAVs (takeoff weight 300–500 kg, range 70–300 km)



Geran-2 UAV
(kamikaze)



BOBER UAV (Ukraine)
(kamikaze)

Types and classes of UAVs

RUSSIAN UNIVERSAL CLASSIFICATION

- Heavy medium-range UAVs (takeoff weight over 500 kg, range 70–300 km)
- Heavy UAVs with long flight duration (takeoff weight over 1,500 kg)



Forpost UAV
(multi-purpose)



Bayraktar TB-2 UAV

Types and classes of UAVs

RUSSIAN UNIVERSAL CLASSIFICATION

Super-heavy - with a take-off weight of more than 1500 kg



Orion UAV
(multi-purpose)



MQ-9 Reaper UAV
(multi-purpose)

Author's comment: There are many classifications. In this case, using the example of the Russian universal lecturer, the author explains in general terms the differences in concepts, technical characteristics, and tactics for using various classes of aircraft-type UAVs.

Types and classes of UAVs

UAV AIRCRAFT TYPE

Use of the Molniya-2 strike UAV

1. Calculation of operators UAV carries out pre-flight preparation



2. UAV takes off from the catapult and heads to the combat mission area



3. Drone control controlled using a remote control and IPV glasses



4. Targets are destroyed by approaching the enemy's blind spot and detonating explosives

Types and classes of UAVs

UAV AIRCRAFT TYPE

Use of the Supercam S350 reconnaissance UAV

1. Calculation of operators UAV carries out pre-flight preparation



2. UAV takes off from the catapult and heads to the combat mission area



Author's comment: t



3. Drone control is performed using a control panel and PC monitor



4. Reconnaissance, correction, and objective monitoring in the visible and IR (thermal imaging) ranges

and control of such machines take place under different conditions

Types and classes of UAVs

MULTI-ROTOR UA

UAVs with two or more independent propellers. The reactive forces are balanced by rotating the propellers in pairs in opposite directions. They are used for reconnaissance, surveillance, striking ground targets, and fire correction.



DJI Mavic 2 quadcopter with grenade launcher



İPV kamikaze drone with a warhead based on an RPG-7 rocket

Types and classes of UAVs

MULTI-ROTOR UA

USED FOR AIR RECONNAISSANCE AND EQUIPPED WITH DROP DEVICES

DJI Mavic Pro Platinum



Weight, g – 734 Maximum
speed (km/h) – 65
Battery capacity, mAh – 3830
Maximum flight altitude, m – 5000
Maximum control signal range, km – 7
Flight time, min – 30
Maximum permissible wind speed, m/s – 10
Positioning system – GPS, GLONASS
Operating temperature range, °C – 0...+40
Photo and video system, magnification factor, x8

Autel EVO



Weight, g – 595 Maximum
speed (km/h) – 68.4
Battery capacity, mAh – 3500 Maximum
flight altitude, m – 5000
Max control signal range, km – 12
Flight time, min – 31
Maximum permissible wind speed, m/s – 10
Positioning system – GPS, GLONASS, Galileo
Operating temperature range, °C – 0...+40
Photo and video system, magnification factor – 8x

DJI PHANOM 3



Weight, g – 1216
Maximum speed (km/h) – 57.6
Battery capacity, mAh – 4480
Maximum flight altitude, m – 6000
Maximum control signal range, km – 8
Flight time, min – 25
Maximum permissible wind speed, m/s – 10
Positioning system – GPS
Operating temperature range, °C – 0...+40
Photo and video system, magnification factor, x8

DJI MAVIC 3



Weight, g – 895 Maximum
speed (km/h) – 68.4
Battery capacity, mAh – 5000
Maximum flight altitude, m – 6000
Maximum control signal range, km – 15
Flight time, min – 46
Maximum permissible wind speed, m/s – 12
Positioning system – GPS, Galileo, BeiDou
Operating temperature range, °C: -10 to +40
Photo and video system, magnification ratio of the central viewfinder, x28

Types and classes of UAVs

MULTI-ROTOR UA

RECONNAISSANCE USING MULTIROTOR UAVS EXPANDS TACTICAL CAPABILITIES



1. Coordination of movements in conditions of poor visibility



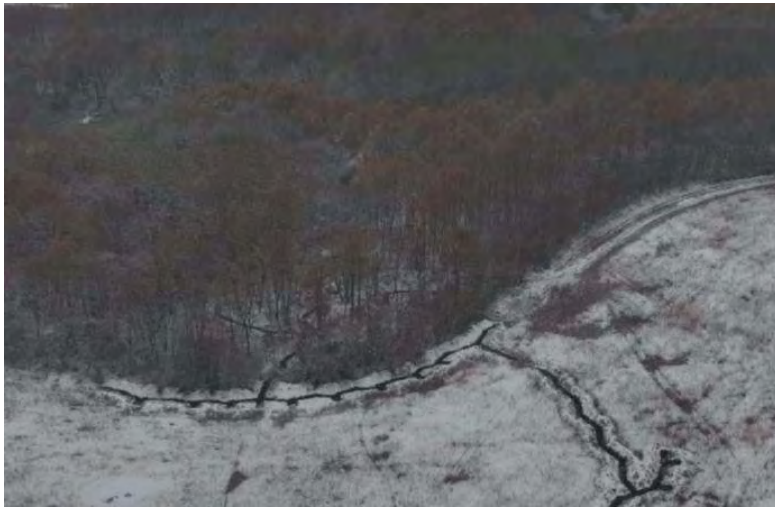
2. Fire correction and aerial reconnaissance, coordination in attack and defense

Types and classes of

UAVs

MULTI-ROTOR UA

AIR RECONNAISSANCE FROM A COPTER AND SUBSEQUENT TARGET ENGAGEMENT USING İPV DRONES



1. Aerial reconnaissance (altitude approx. 300 m, distance approx. 1 km)



2. Detection and recognition of targets by characteristic unmasking signs



3. Destruction of targets using İPV drones and artillery

Use of UAVs

ARTILLERY FIRE CORRECTION WITH UAVs (GENERAL)

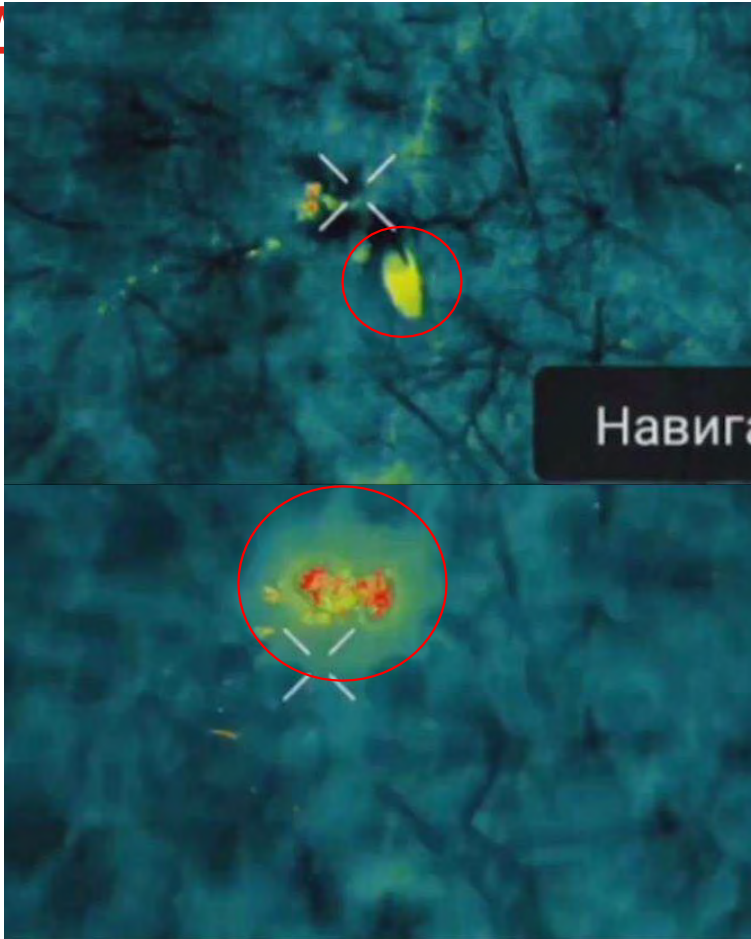
1. Interaction with artillerymen. A common method of adjusting artillery fire is by cardinal directions. When a target is detected by a reconnaissance drone, the spotter compares the terrain with a map installed on a phone/navigator (or a regular map).
2. After comparing the target location with the map, the spotter determines the flat rectangular coordinates of the target X, Y, and transmits them to the artillerymen via communication devices.
3. After transmitting the target coordinates to the artillerymen via communication devices, the spotter gives the command to begin firing. Observing the explosion, the spotter determines in which direction the explosion deviated and determines the amount of deviation from the target in meters.
4. The amount of deviation is transmitted to the artillerymen. For example: if the explosion occurred 150 meters from the target, on the south side, the spotter indicates "150 meters south," thereby indicating the location of the explosion in relation to the target.
5. During further fire correction, if the explosions fall 50 meters from the target, the spotter gives the command to lay down a barrage of fire, and the artillerymen fire a wall of fire at the target to destroy it.



Types and classes of UAVs

Detection and tracking of targets in the thermal imaging range, altitude from 50-300 m

The priority target for release is the concentration of infantry and equipment



Footage of grenades being dropped from multi-rotor UAVs in the thermal imaging range

DROPPING EXPLOSIVES FROM MULTIROTOR UAVs

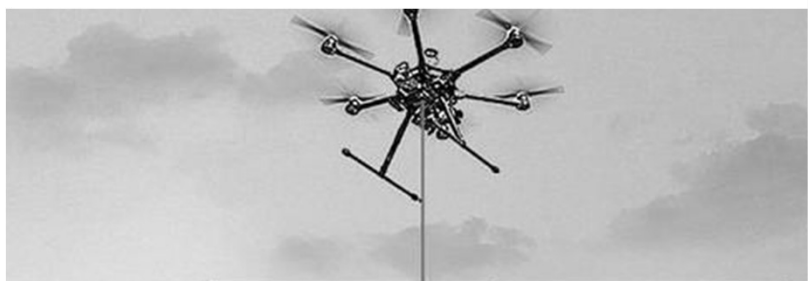


During discharge:
the UAV
descends to improve
accuracy
30-100 m

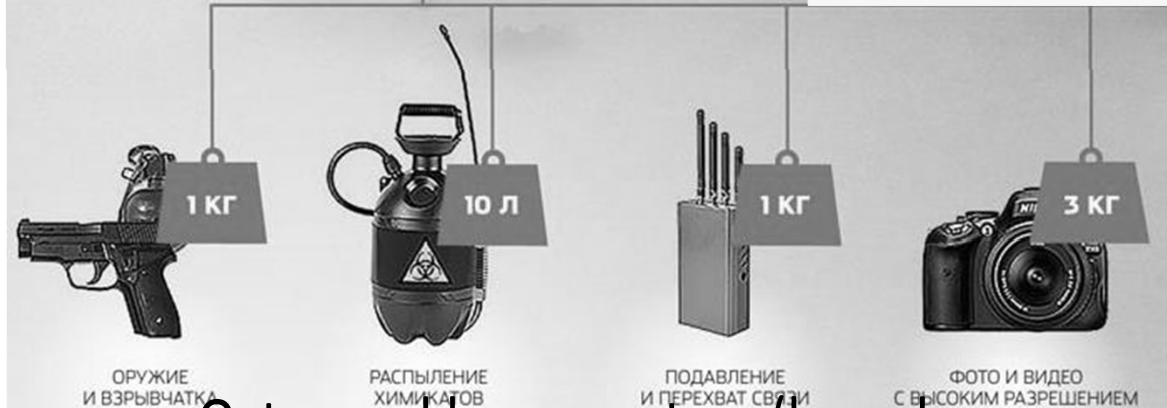
After release:
The UAV climbs
to avoid being
hit by the blast
wave and/or
debris
up to 250 m

Types and classes of UAVs

HEAVY MULTIROTOR UAVS



Baba Yaga is a heavy multicopter, most models of which have six propeller motor groups. The take-off weight of such drones can reach 50–60 kg. In the basic configuration, heavy copters are usually equipped with a remote control system and autopilot. They are widely and universally used: for strikes, mining, electronic warfare, etc.



Octo- and hexa-copters (based on agro-industrial drones)



A so-called "Baba Yaga" type drone in the thermal imaging range

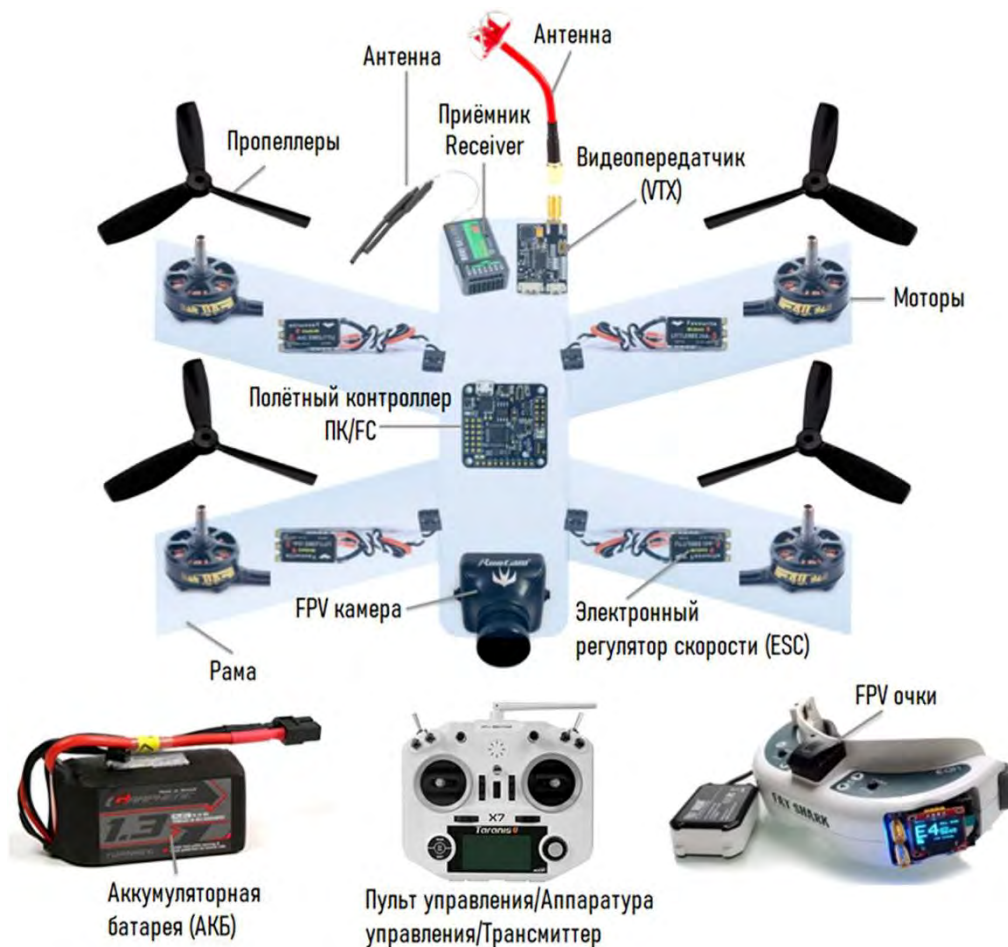
Types and classes of UAVs

Operator of an IPV drone



IPV-drone "Kolibri" (Ukraine)

IPV-DRONES ("KAMIKAZE")



Typical UAV device

Types and classes of UAVs

İPV-DRONES ("KAMIKAZE")



1. Approaching the target
(in this case, a dugout)



2. Copter explosion



3. The reconnaissance UAV
provides objective
monitoring

Author's comment: It is important to note the high maneuverability of such drones (different speeds, movement along trenches and between trees), and to mention the need to close gaps/windows and doors, as an experienced operator can perform complex maneuvers and catch personnel off guard

Types and classes of UAVs

Footage of the use of İPV drones ("kamikaze")



İPV drones with cumulative ammunition are extremely effective in combating equipment



Direct first-person control allows you to effectively hit moving targets



As well as hitting hard-to-reach targets such as repeaters, antennas, etc.

Types and classes of UAVs

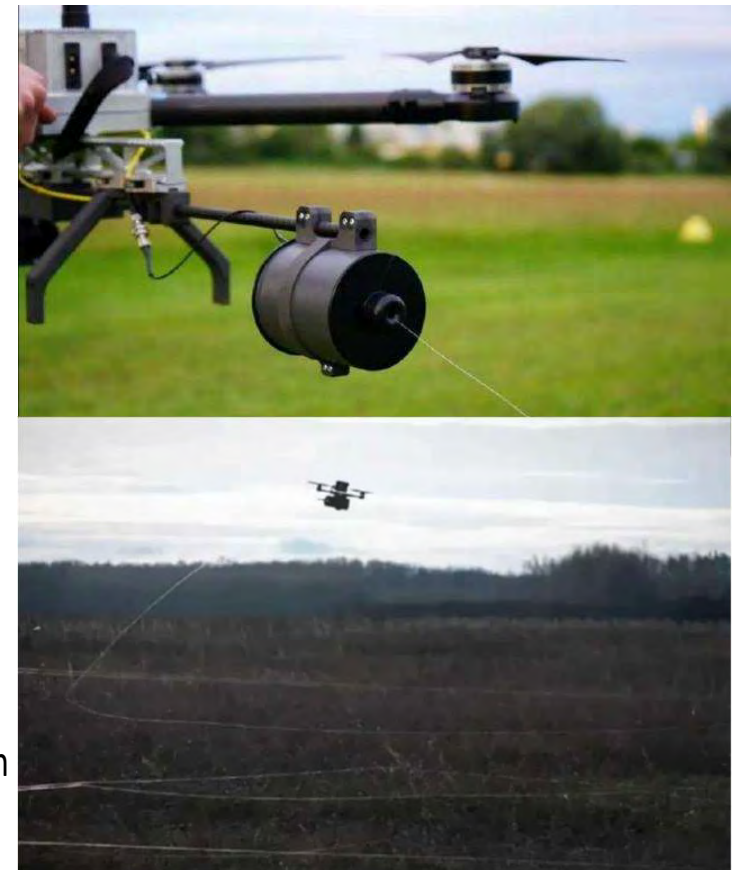
Fiber optic UAVs are connected to the base station using thin reinforced fiber optic cable for transmitting video signals and control commands.

SOME ADVANTAGES OF FIBER OPTIC UAVS:

- Stable connection. Fiber optic cable provides a constant communication channel, regardless of environmental conditions.
- Data security. The cable cannot be connected to "from the outside," it cannot be hacked, and the information transmitted through it cannot be intercepted.
- Resistance to interference. Fiber optics are immune to electromagnetic interference.
- Clear and smooth picture. The cable allows for distortion-free high-resolution transmission at any distance.
- Reduced energy consumption.

Author's comment: a frequently asked question is "can this cable be cut, and what will happen to the drone?" The answer is that it will lose signal, resulting in loss of control and detonation of the warhead.

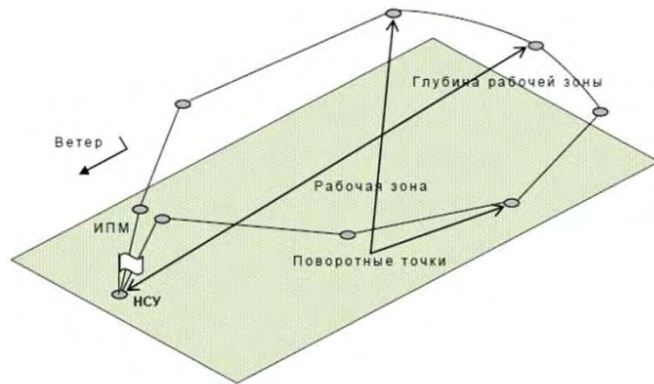
İPV DRONES ("KAMIKAZE") on fiber optics



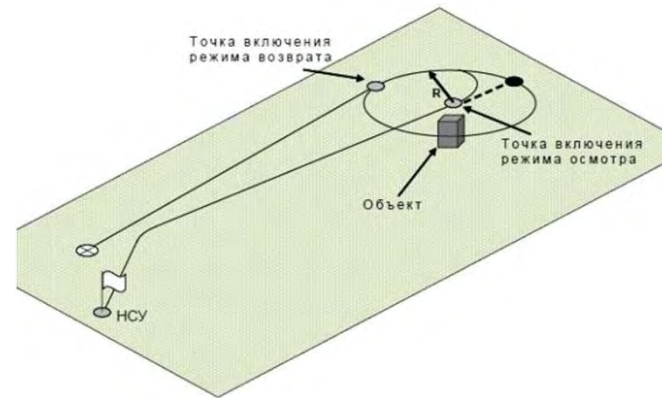
An

Types and classes of UAVs

TYPICAL ROUTES FOR RECONNAISSANCE UAVs

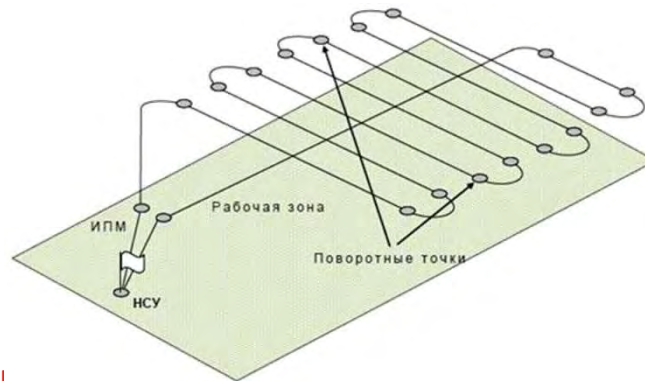


A closed circular route is used for general inspection of the territory

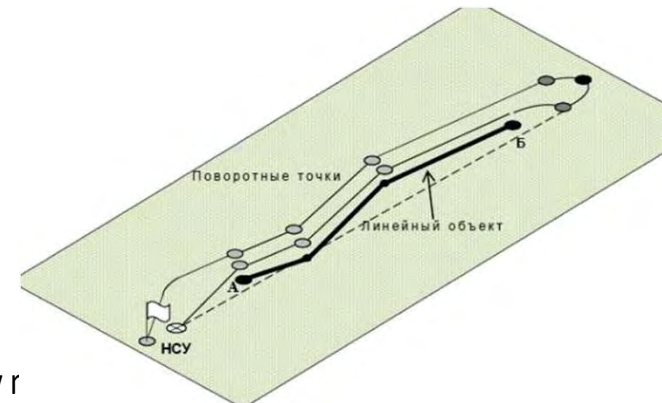


Flight around a specified object

Used in cases where the coordinates of the object are known and its condition needs to be clarified.



For a detailed inspection of individual areas within the working zone, straight, mutually parallel routes are used.



Flight over a linear object

Used to monitor linear objects when their position or direction of movement is known.

During the Cold War, reconnaissance UAVs were used by the US and the Soviet Union. In the post-war period, more complex flight patterns were used, such as the so-called "daisy" pattern, which confuses the observer and allows the UAV to approach from a new angle each time.

Types and classes of UAVs

Silhouettes of UAVs (Russian)

Елерон-10



Елерон-3



ZALA 421-16E



Застава



Орлан-10



Може скидати ВОГ-25



Гранат-2



Типчак



Гранат-4



E95M



КУБ-БЛА



Ударний!
На землі не чіпати!



Груша



Гранат-1



Zala 421-08



Тахион



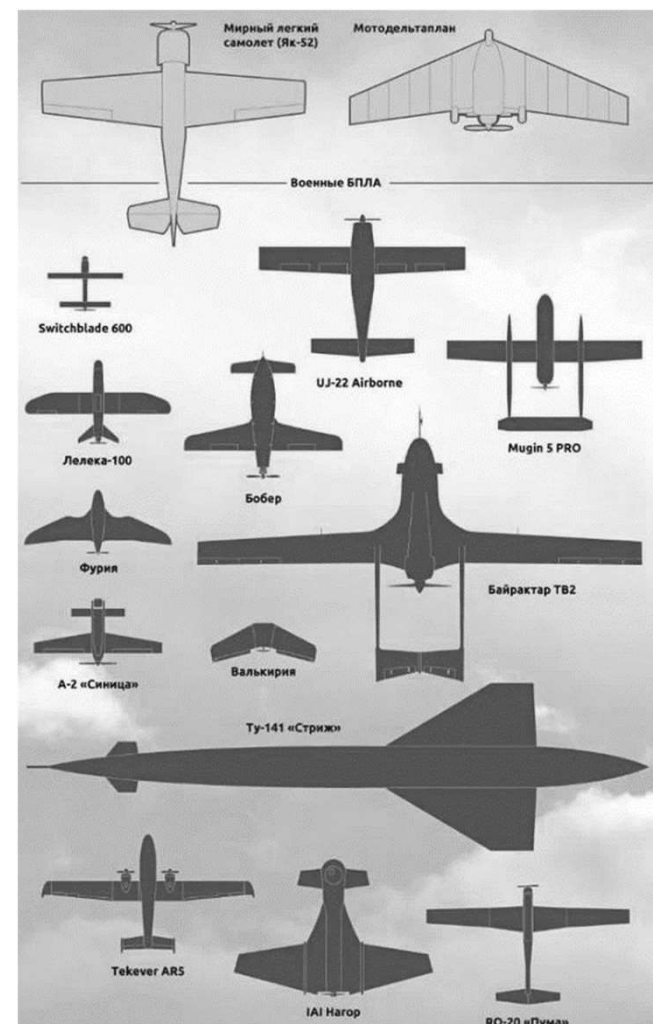
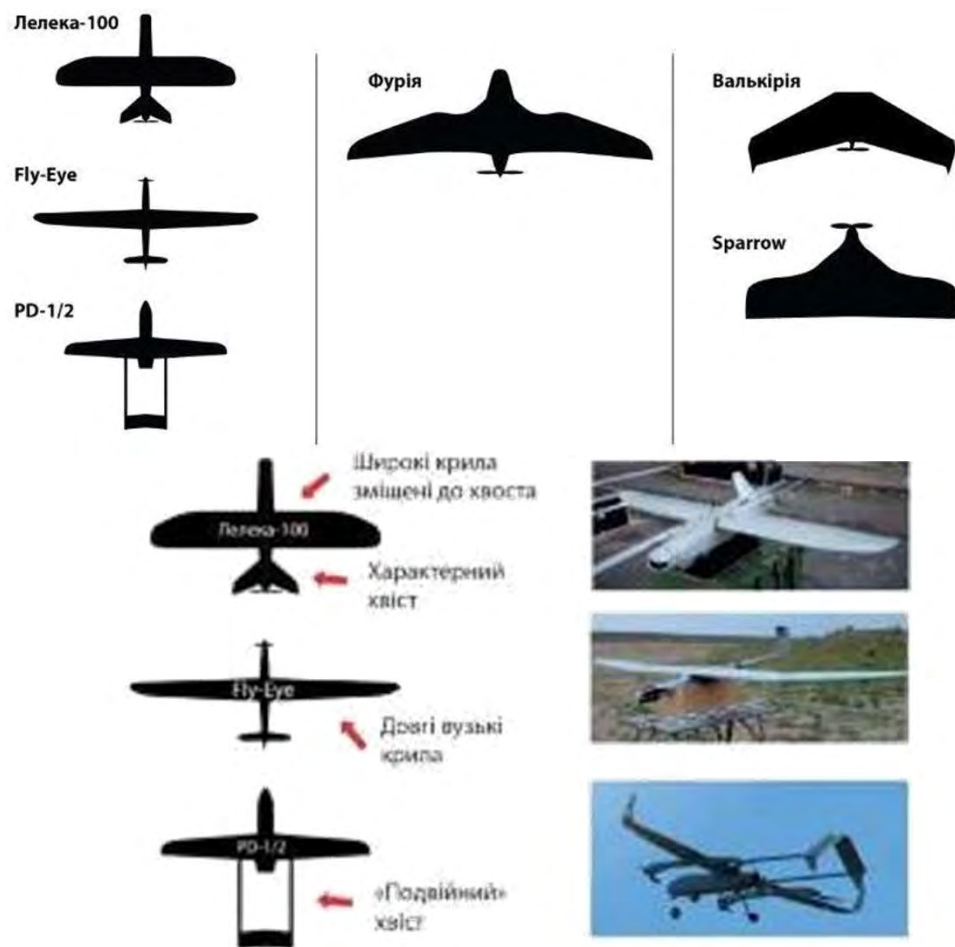
Zala 421-04



Comment from the author: These machines are only a small part of the UAVs used in the SVO zone. Study the models used in your area in detail.

Types and classes of UAVs

Silhouettes of UAVs (Ukraine)

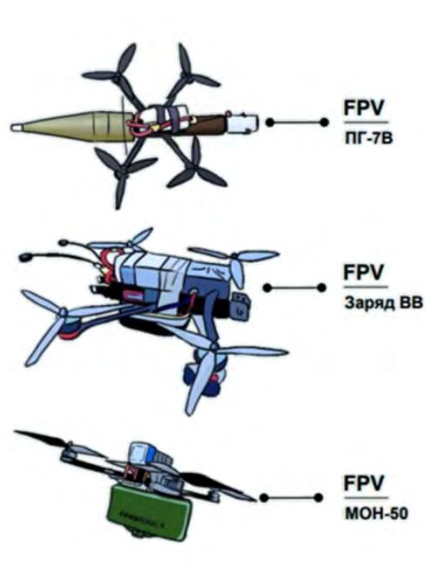


Author's comment: These machines are only a small part of the UAVs used in the ATO zone. Take into account mimicry of Russian UAVs and new models.

Types and classes of UAVs

Light multicopter-type UAVs

FPV



Предназначение
разведывательный
с возможностью сброса боеприпаса

БПЛА DJI «Мейвик-3» (КНР)

Тип двигателя
электрический



МАССА	ДАЛЬНОСТЬ	СКОРОСТЬ	ВРЕМЯ ПОЛЕТА	МАССА	ДАЛЬНОСТЬ	СКОРОСТЬ	ВРЕМЯ ПОЛЕТА
до 1,5 кг с грузом – до 2 кг	до 7 км	до 150 км/ч с грузом – до 100 км/ч	до 7-10 мин с грузом – до 7 мин	895 г	15 км	максимальная – 75 км/ч	до 46 мин

Types and classes of UAVs

Lightweight copter-type UAVs with increased payload capacity



БПЛА Маллоу Т150 (Великобритания)

Предназначение

грузовой
с возможностью ведения разведки
и сброса боеприпаса



МАССА

25 кг

ДАЛЬНОСТЬ

70 км

СКОРОСТЬ

максимальная – 48 км/ч

ВРЕМЯ ПОЛЕТА

до 36 мин



БПЛА «Револьвер 860» (Тайвань)

Предназначение

ударный
с возможностью ведения разведки



МАССА

42 кг

ДАЛЬНОСТЬ

до 20 км

СКОРОСТЬ

крейсерская – 20 км/ч
максимальная – 30 км/ч

ВРЕМЯ ПОЛЕТА

до 40 мин

Types and classes of UAVs

ОКТОКОПТЕР R-18/ЕП E610

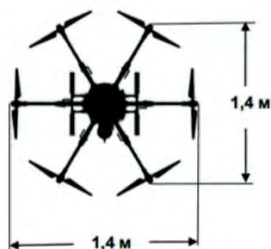


БПЛА ЕПТ Е 610 (КНР)

Предназначение

ударный
с возможностью ведения разведки

Масса полезной нагрузки
до 10 кг



Тип двигателя
электрический

МАССА

15 кг

ДАЛЬНОСТЬ

20 км

СКОРОСТЬ

максимальная – 35 км/ч

ВРЕМЯ ПОЛЕТА

до 1 ч



Types and classes of UAVs

Micro helicopter-type UAV



БпЛА «Блек Хорнет» (Великобритания)

Предназначение
разведывательный



Тип двигателя
электрический



МАССА

33 г

ДАЛЬНОСТЬ

до 2 км

СКОРОСТЬ

максимальная – 22 км/ч

ВРЕМЯ ПОЛЕТА

до 25 мин

Types and classes of UAVs

Light reconnaissance aircraft-type UAVs (USA)

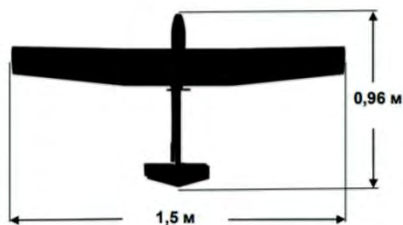


БпЛА RQ-11 «Равен» (США)

Предназначение
разведывательный



Тип двигателя
электрический



МАССА	ДАЛЬНОСТЬ	СКОРОСТЬ	ВРЕМЯ ПОЛЕТА
1,7 кг	до 10 км	крейсерская – 95 км/ч максимальная – 105 км/ч	до 1 ч

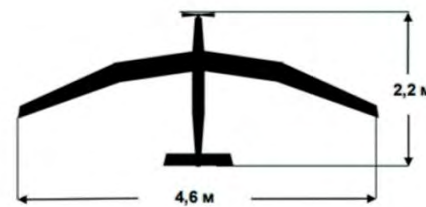


БпЛА «Puma LE» (США)

Предназначение
разведывательный



Тип двигателя
электрический



Масса полезной нагрузки
до 2,5 кг

МАССА	ДАЛЬНОСТЬ	СКОРОСТЬ	ВРЕМЯ ПОЛЕТА
10,7 кг	до 60 км	крейсерская – 47 км/ч максимальная – 76 км/ч	до 5,5 ч

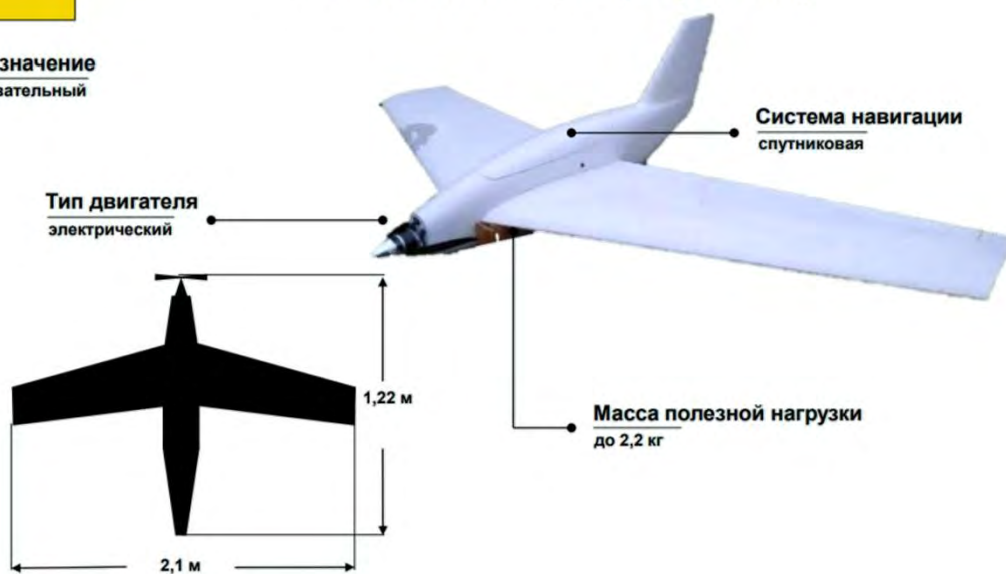
Types and classes of UAVs

Light reconnaissance aircraft-type UAVs (Ukraine)



Предназначение
разведывательный

БПЛА «Эльф» (Украина)



МАССА
6,2 кг

ДАЛЬНОСТЬ
до 150 км

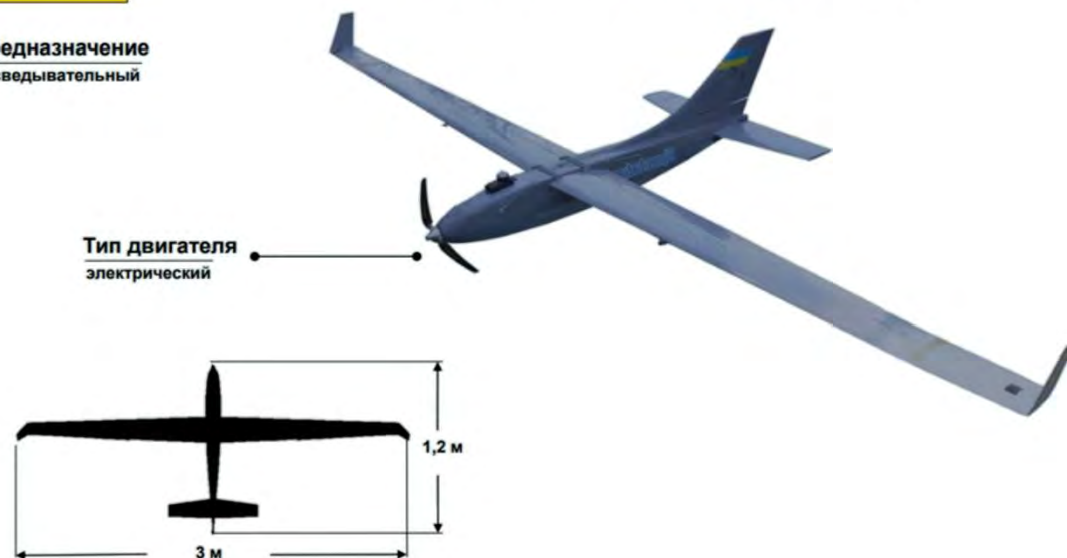
СКОРОСТЬ
крейсерская – 85 км/ч
максимальная – 140 км/ч

ВРЕМЯ ПОЛЕТА
до 2 ч



Предназначение
разведывательный

БПЛА «Спектратор» (Украина)



МАССА
5,5 кг

ДАЛЬНОСТЬ
до 150 км

СКОРОСТЬ
крейсерская – 90 км/ч
максимальная – 120 км/ч

ВРЕМЯ ПОЛЕТА
до 2 ч

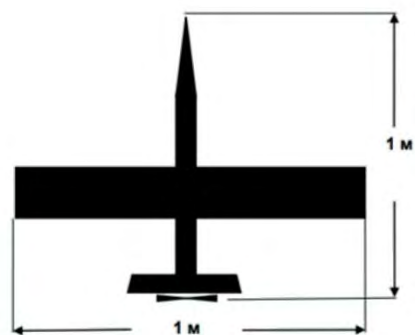
Types and classes of UAVs

Light aircraft-type kamikaze UAVs (Ukraine)



БпЛА UJ-32 «Ластивка» (Украина)

Предназначение
дрон-камикадзе



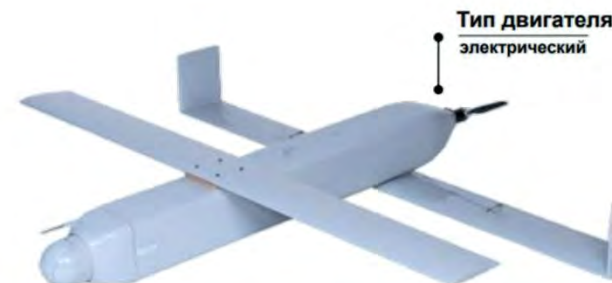
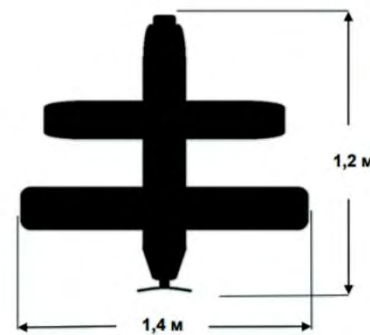
Боевая часть
граната ПГ-7

Тип двигателя
электрический



БпЛА «Пилум» (Украина)

Предназначение
дрон-камикадзе



Масса боевой части
до 7 кг

Тип двигателя
электрический

МАССА
8 кг

ДАЛЬНОСТЬ
до 40 км

СКОРОСТЬ
крейсерская – 100 км/ч
максимальная – 180 км/ч

ВРЕМЯ ПОЛЕТА
до 20 мин

МАССА
10 кг

ДАЛЬНОСТЬ
до 40 км

СКОРОСТЬ
крейсерская – 90 км/ч
максимальная – 110 км/ч

ВРЕМЯ ПОЛЕ
до 30 мин

Types and classes of UAVs

Light aircraft-type kamikaze UAVs



БпЛА «Рам-2» (Украина)

Предназначение
дрон-камикадзе



МАССА
8 кг

ДАЛЬНОСТЬ
до 30 км

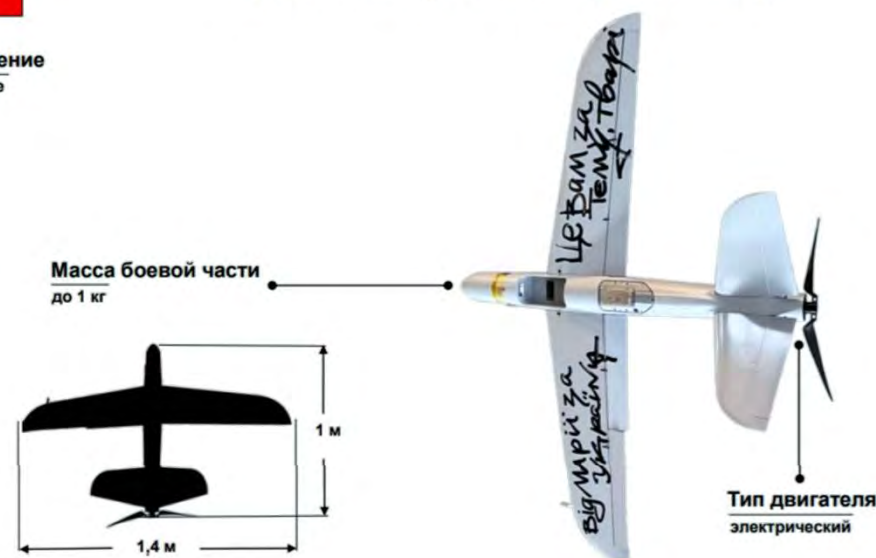
СКОРОСТЬ
крейсерская – 65 км/ч
максимальная – 130 км/ч

ВРЕМЯ ПОЛЕТА
до 55 мин



БпЛА «Вармейт» (Польша)

Предназначение
дрон-камикадзе



МАССА
4 кг

ДАЛЬНОСТЬ
до 10 км

СКОРОСТЬ
крейсерская – 100 км/ч
максимальная – 150 км/ч

ВРЕМЯ ПОЛЕТА
до 30 мин

Types and classes of UAVs

Light reconnaissance UAVs of the "flying wing" (Ukraine)



Предназначение
разведывательный

БПЛА «Скиф» (Украина)



МАССА
3,8 кг

ДАЛЬНОСТЬ
до 130 км

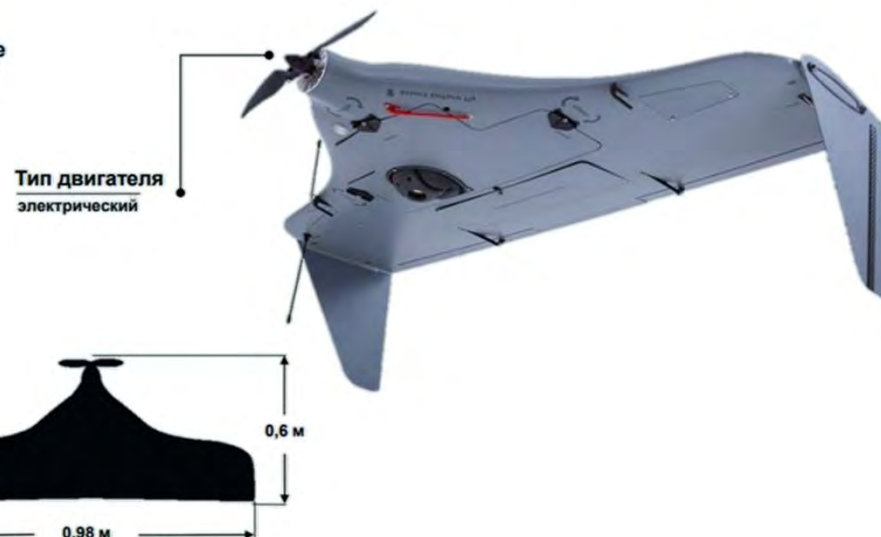
СКОРОСТЬ
крейсерская – 70 км/ч
максимальная – 90 км/ч

ВРЕМЯ ПОЛЕТА
до 2 ч



Предназначение
разведывательный

БПЛА «Спарроу» (Украина)



МАССА
4 кг

ДАЛЬНОСТЬ
15 км

СКОРОСТЬ
крейсерская – 80 км/ч
максимальная – 100 км/ч

ВРЕМЯ ПОЛЕТА
до 1 ч

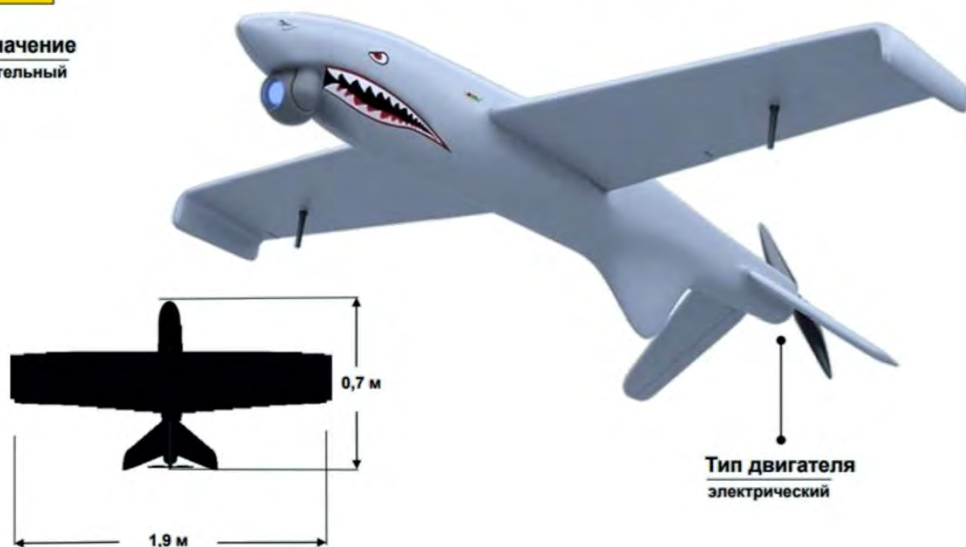
Types and classes of UAVs

Light reconnaissance aircraft-type UAVs (Ukraine)



Предназначение
разведывательный

БпЛА «Шарк» (Украина)



МАССА
10 кг

ДАЛЬНОСТЬ
до 100 км

СКОРОСТЬ
крейсерская – 90 км/ч
максимальная – 150 км/ч

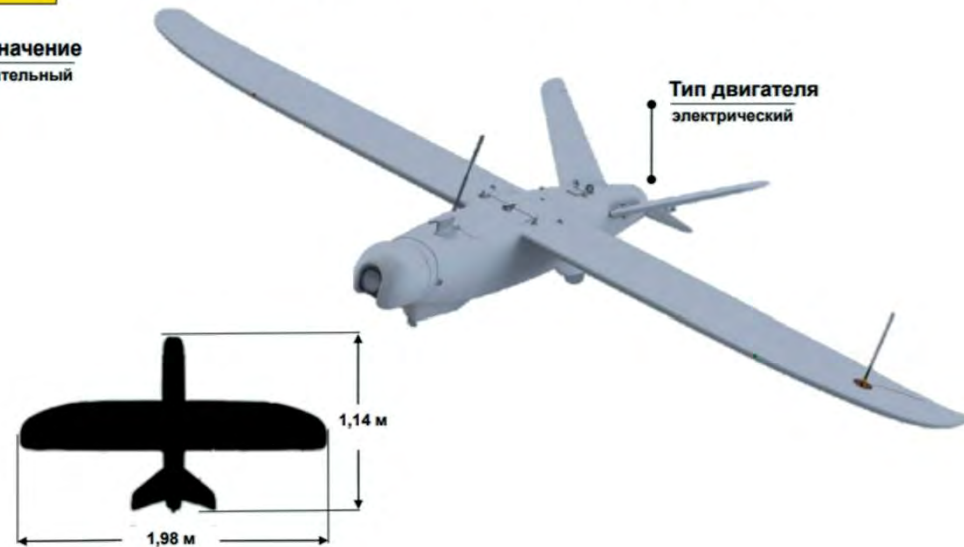
ВРЕМЯ ПОЛЕТА
до 2 ч

13



Предназначение
разведывательный

БпЛА «Лелека-100» (Украина)



МАССА
5 кг

ДАЛЬНОСТЬ
до 100 км

СКОРОСТЬ
крейсерская – 65 км/ч
максимальная – 100 км/ч

ВРЕМЯ ПОЛЕТА
до 3 ч

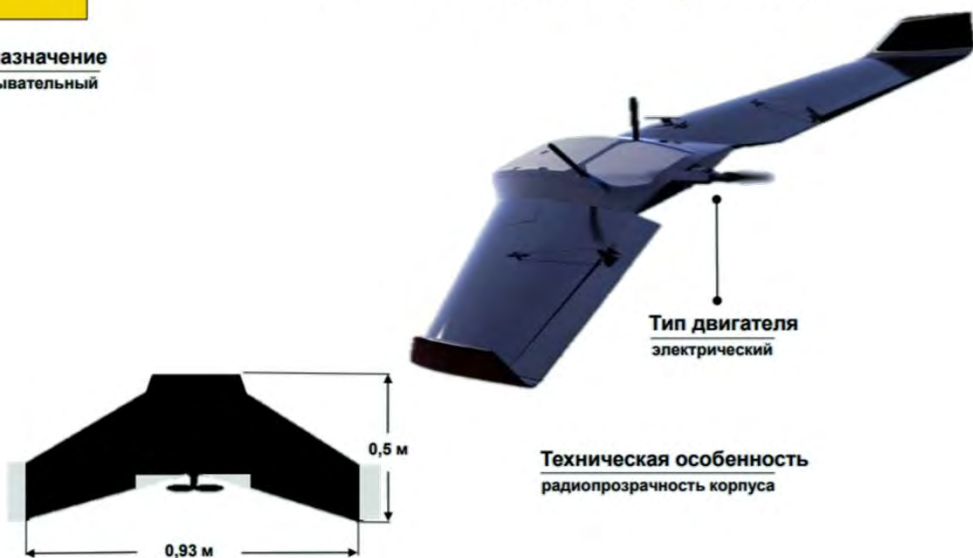
13

Types and classes of UAVs



БпЛА «Сирко» (Украина)

Предназначение
разведывательный



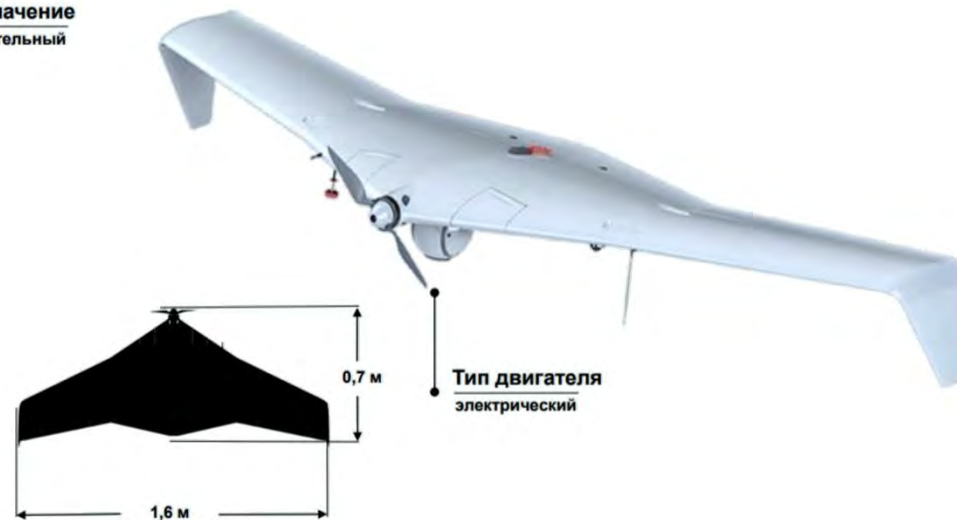
МАССА	ДАЛЬНОСТЬ	СКОРОСТЬ	ВРЕМЯ ПОЛЕТА
1,37 кг	50 км	крейсерская – 70-80 км/ч максимальная – 120 км/ч	до 70 мин

145



БпЛА «Раллус» (Украина)

Предназначение
разведывательный



МАССА	ДАЛЬНОСТЬ	СКОРОСТЬ	ВРЕМЯ ПОЛЕТА
5,5 кг	до 100 км	крейсерская – 60 км/ч максимальная – 70 км/ч	до 2 ч

14

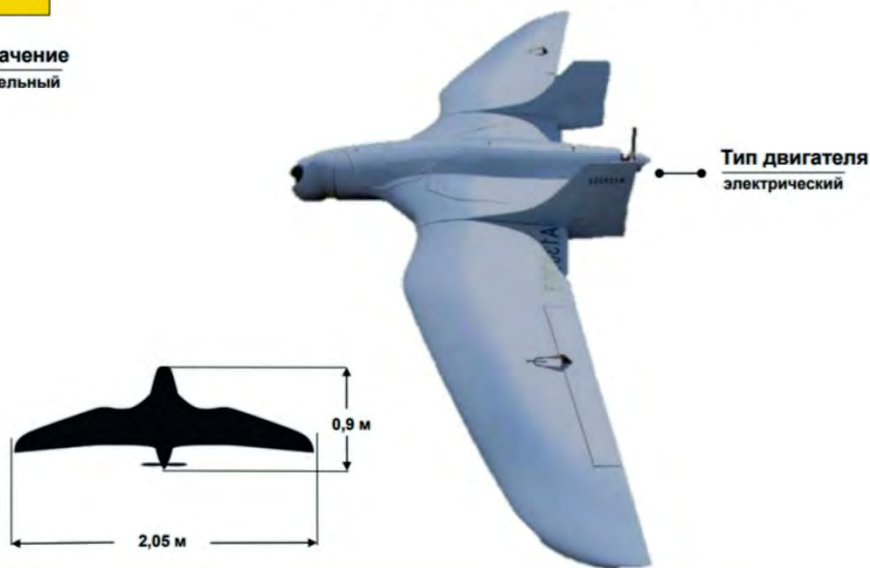
Types and classes of UAVs

Light reconnaissance UAVs of the "flying wing" (Ukraine)



БПЛА «Фурия» (Украина)

Предназначение
разведывательный



МАССА
5,5 кг

ДАЛЬНОСТЬ
до 200 км

СКОРОСТЬ
крейсерская – 65 км/ч
максимальная – 140 км/ч

ВРЕМЯ ПОЛЕТА
до 3 ч



БПЛА «Валькирия» (Украина)

Предназначение
разведывательный



МАССА
4,95 кг

ДАЛЬНОСТЬ
до 40 км

СКОРОСТЬ
крейсерская – 60 км/ч
максимальная – 108 км/ч

ВРЕМЯ ПОЛЕТА
до 2 ч

Types and classes of UAVs

Light reconnaissance UAVs aircraft-type (Ukraine)



БПЛА «Raybird-3» (Украина)

Предназначение
разведывательный

Тип двигателя
ДВС



МАССА

11 кг

ДАЛЬНОСТЬ

до 2500 км

СКОРОСТЬ

крейсерская – 120 км/ч
максимальная – 160 км/ч

ВРЕМЯ ПОЛЕТА

до 32 ч



БПЛА Punisher «Каратель» (Украина)

Предназначение
дрон-камикадзе

Масса полезной нагрузки
до 2 кг

Тип двигателя
электрический



МАССА

5,5 кг

ДАЛЬНОСТЬ

до 45 км

СКОРОСТЬ

крейсерская – 80 км/ч
максимальная – 198 км/ч

ВРЕМЯ ПОЛЕТА

до 30 мин

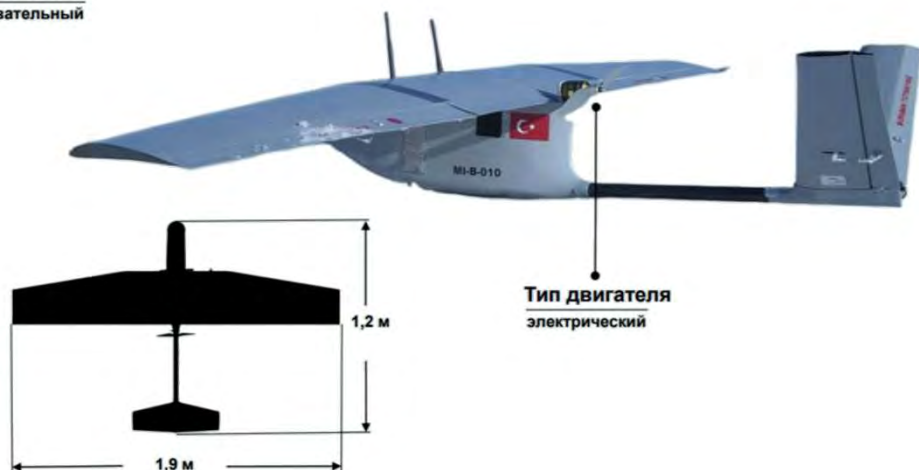
Types and classes of UAVs

Light reconnaissance aircraft-type UAVs (NATO)



БПЛА «Байрактар мини» (Турция)

Предназначение
разведывательный



МАССА
4,5 кг

ДАЛЬНОСТЬ
до 15 км

СКОРОСТЬ
крейсерская – 60 км/ч
максимальная – 75 км/ч

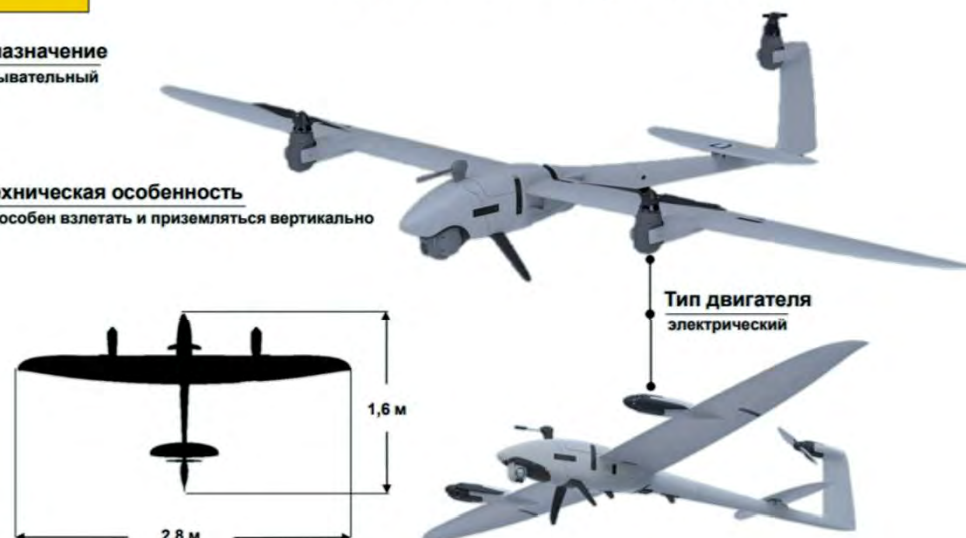
ВРЕМЯ ПОЛЕТА
до 1 ч



БПЛА «Вектор» (ФРГ)

Предназначение
разведывательный

Техническая особенность
способен взлетать и приземляться вертикально



МАССА
7,4 кг

ДАЛЬНОСТЬ
25 км

СКОРОСТЬ
крейсерская – 70 км/ч
максимальная – 90 км/ч

ВРЕМЯ ПОЛЕТА
до 2 ч

Types and classes of UAVs

Light reconnaissance and strike aircraft-type UAVs (Ukraine)



БпЛА ACS-3М (Украина)

Предназначение
разведывательно-ударный

Тип двигателя
ДВС



МАССА

23 кг

ДАЛЬНОСТЬ

до 1000 км
макс. 2500 км

СКОРОСТЬ

крейсерская – 120 км/ч
максимальная – 160 км/ч

ВРЕМЯ ПОЛЕТА

до 30 ч

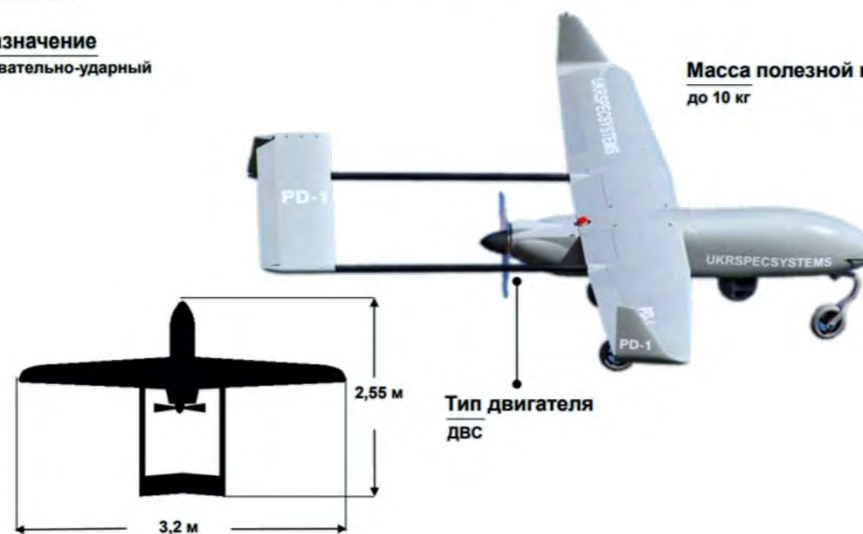
127



БпЛА PD-1 (Украина)

Предназначение
разведывательно-ударный

Масса полезной нагрузки
до 10 кг



МАССА

33 кг

ДАЛЬНОСТЬ

до 100 км

СКОРОСТЬ

крейсерская – 90 км/ч
максимальная – 140 км/ч

ВРЕМЯ ПОЛЕТА

до 10 ч

123

Types and classes of UAVs

Light kamikaze UAVs of the United States



Предназначение
дрон-камикадзе

Барражирующий боеприпас «Свичблейд 300» (США)



МАССА

2,5 кг

ДАЛЬНОСТЬ

до 10 км

СКОРОСТЬ

крейсерская – 100 км/ч
максимальная – 160 км/ч

ВРЕМЯ ПОЛЕТА

до 15 мин



Предназначение
дрон-камикадзе

Барражирующий боеприпас «Свичблейд 600» (США)



МАССА

22,7 кг

ДАЛЬНОСТЬ

до 40 км

СКОРОСТЬ

крейсерская – 110 км/ч
максимальная – 185 км/ч

ВРЕМЯ ПОЛЕТА

до 40 мин

Types and classes of UAVs

Medium reconnaissance and strike Aircraft-type UAVs



БПЛА Н 10 «Посейдон» VTOL (Кипр)

Предназначение
разведывательный



МАССА

22 кг

ДАЛЬНОСТЬ

до 150 км

СКОРОСТЬ

крейсерская – 75 км/ч
максимальная – 100 км/ч

ВРЕМЯ ПОЛЕТА

до 2,5 ч



БПЛА «Мугин-5 Про» (КНР)

Предназначение
разведывательно-ударный



МАССА

90 кг

ДАЛЬНОСТЬ

400 км

СКОРОСТЬ

крейсерская – 120 км/ч
максимальная – 150 км/ч

ВРЕМЯ ПОЛЕТА

до 7 ч

Types and classes of UAVs

Medium reconnaissance and strike Aircraft-type UAVs



БпЛА «Рарог» (Польша)

Предназначение
разведывательно-ударный



МАССА

40 кг

ДАЛЬНОСТЬ

до 100 км

СКОРОСТЬ

крейсерская – 100 км/ч
максимальная – 150 км/ч

ВРЕМЯ ПОЛЕТА

до 12 ч

125



БпЛА «Примоко UAV One 150» (Чехия)

Предназначение
разведывательно-ударный



МАССА

150 кг

ДАЛЬНОСТЬ

до 2000 км

СКОРОСТЬ

крейсерская – 100 км/ч
максимальная – 180 км/ч

ВРЕМЯ ПОЛЕТА

до 15 ч

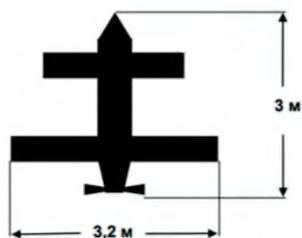
Types and classes of UAVs

Medium aircraft-type kamikaze UAVs



БПЛА AQ-400 «Коса» (Украина)

Предназначение
дрон-камикадзе



МАССА

125 кг

ДАЛЬНОСТЬ

750 км

СКОРОСТЬ

крейсерская – 140 км/ч
максимальная – 200 км/ч

ВРЕМЯ ПОЛЕТА

до 5 ч



БПЛА «Бобер» (Украина)

Предназначение
дрон-камикадзе



МАССА

150 кг

ДАЛЬНОСТЬ

до 1000 км

СКОРОСТЬ

крейсерская – 120 км/ч
максимальная – 150 км/ч

ВРЕМЯ ПОЛЕТА

до 7 ч

Types and classes of UAVs

Medium reconnaissance and strike Aircraft-type UAVs (Ukraine)



БПЛА UJ-22 «Эарбон» (Украина)

Предназначение
разведывательно-ударный



Тип двигателя
ДВС

Масса полезной нагрузки
до 20 кг



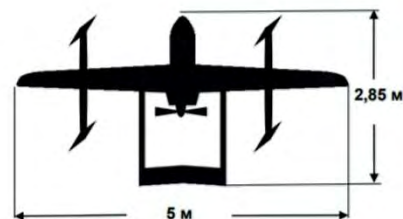
БПЛА PD-2 (Украина)

Предназначение
разведывательно-ударный



Масса полезной нагрузки
до 11 кг

Тип двигателя
гибридный



МАССА	ДАЛЬНОСТЬ	СКОРОСТЬ	ВРЕМЯ ПОЛЕТА	МАССА	ДАЛЬНОСТЬ	СКОРОСТЬ	ВРЕМЯ ПОЛЕТА
86 кг	800 км	крейсерская – 120 км/ч максимальная – 200 км/ч	до 8 ч	55 кг	до 1000 км	крейсерская – 100 км/ч максимальная – 140 км/ч	до 8 ч

Types and classes of UAVs

Medium reconnaissance and strike Aircraft-type UAVs (NATO)



БПЛА Н 6 «Посейдон» VTOL (Кипр)

Предназначение
разведывательно-ударный



МАССА
100 кг

ДАЛЬНОСТЬ
до 850 км

СКОРОСТЬ
крейсерская – 110 км/ч
максимальная – 150 км/ч

ВРЕМЯ ПОЛЕТА
до 7 ч

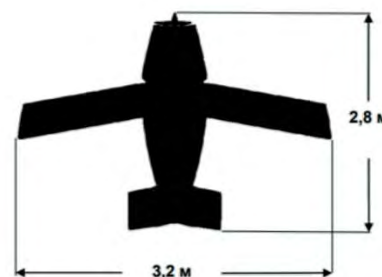
1:128



БПЛА «Иглет» (США)

Предназначение
разведывательно-ударный

Масса полезной нагрузки
до 18 кг



МАССА
90,7 кг

ДАЛЬНОСТЬ
700 км

СКОРОСТЬ
крейсерская – 160 км/ч
максимальная – 213 км/ч

ВРЕМЯ ПОЛЕТА
до 8 ч

Types and classes of UAVs

Heavy reconnaissance Aircraft-type strike UAVs



БПЛА «Байрактар ТВ-2» (Турция)

Предназначение
разведывательно-ударный



БПЛА «Сокол-300» (Украина)

Предназначение
разведывательно-ударный



МАССА	ДАЛЬНОСТЬ	СКОРОСТЬ	ВРЕМЯ ПОЛЕТА	МАССА	ДАЛЬНОСТЬ	СКОРОСТЬ	ВРЕМЯ ПОЛЕТА
650 кг	до 150 км	крейсерская – 130 км/ч максимальная – 222 км/ч	до 24 ч	1225 кг	1300 км	крейсерская – 400 км/ч максимальная – 580 км/ч	до 5 ч

Author's comment: only the main models; new ones appear every day, and studying them is a priority for PVN observers.

Types of UAV ammunition



Standard release systems for DJI MAVIC 3 UAVs

DROP SYSTEMS



Dropping systems based on the interaction between the UAV's lighting and a photosensor, which initiates the drop by mechanically unlocking the lock that prevents the ammunition from falling

Author's comment: Currently, there are many different systems and types of BP for all types of UAVs. The main idea is that there can be several "drops," depending on the takeoff weight of the UAV.

Types of UAV ammunition

- SERIAL AMMUNITION:

Special ammunition OFSP-0.5

- ADAPTED AMMUNITION:

F-1, RGD-5 (RGN) hand grenades

Modified homemade VOG-17 (30 mm), VOG-25 (40 mm), rounds for NATO 40x53 mm grenade launchers, etc.

- HOMEMADE AMMUNITION AND EXPLOSIVES:

Handmade devices based on TNT blocks Incendiary and chemical ammunition

AMMUNITION AND SVU BASE USED FOR DROPPING



Standard ammunition and IEDs used for dropping from UAVs

Author's comment: Homemade and adaptive ammunition is the most dangerous, as the striking element, explosives, and detonation system are modernized—all of which are unpredictable and widely used by the enemy on the front lines without any moral or ethical restrictions.

Types of UAV ammunition

SERIES-PRODUCED WEAPON SYSTEMS

UNIFIED SHATTERING-FUGAS SPECIAL AMMUNITION OFSP

It has a caliber of 48 mm and a length and weight ranging from 0.5 to 2.5 kg, depending on the model.

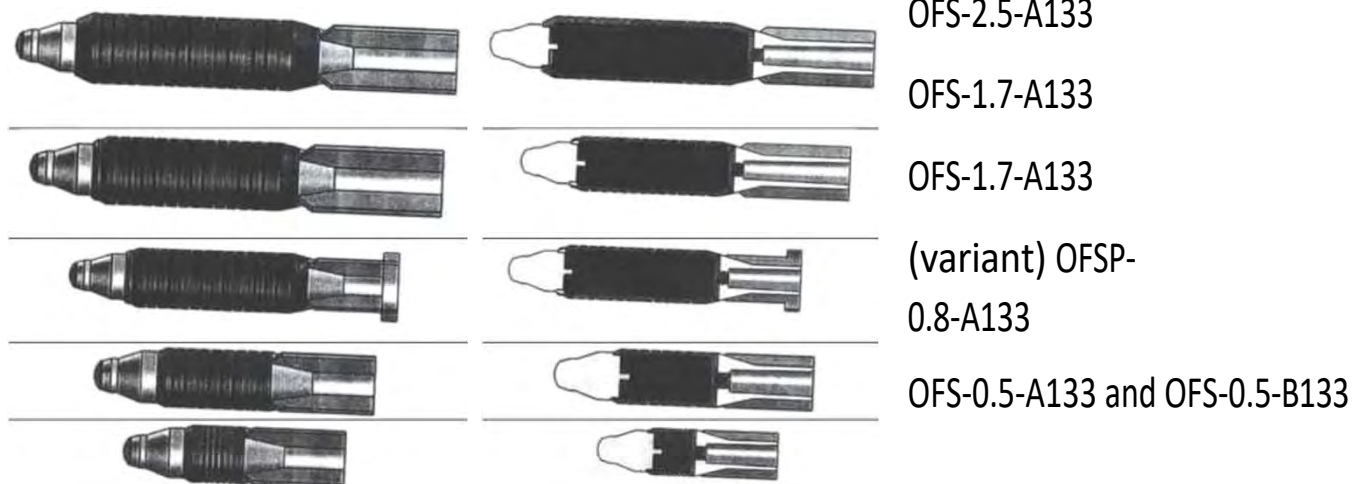
The OFSP-05 (0.5 kg) is used for small quadcopters and aircraft-type UAVs. The PU-11M3 release device is used for the DJI Mavic 3. There are two types of fuses: A133 (for release from a height of at least 250 m) and B133 (with a minimum release height of 30 m). Orlan-10 strike UAVs are equipped with OFSP-08.



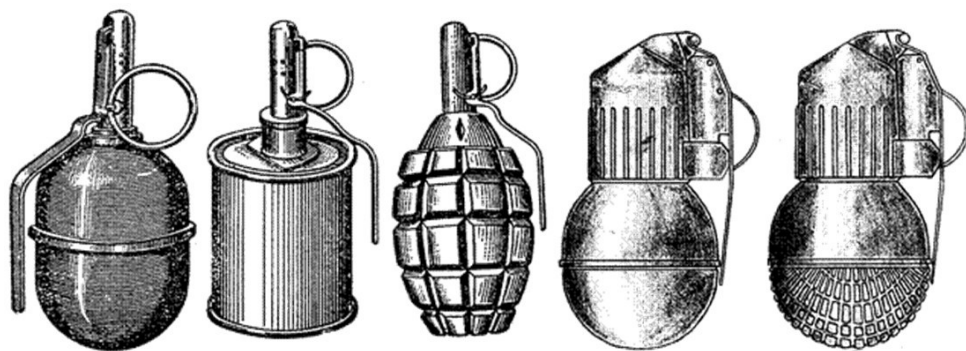
SERIES WEAPON SYSTEM ON THE MAVIC 3
UAV



SERIES AMMUNITION FOR THE ORLAN-10
UAV



Types of UAV ammunition



RGD-5

RG-42

F-1

RGN

RGO



F-1

RGD-5

RGO

RGN

HAND GRENADES

- RGD-5. The radius of lethal grenade fragments is approximately 25 m.
- RG-42. The range of shrapnel is approx. 25 m, and the radius of continuous damage is 5 m.
- F-1. The radius of shrapnel dispersion is 40–50 m, and the safe distance is 200 m. The number of shrapnel fragments after detonation is up to 300.
- RGN. Upon explosion, the grenade produces 220–300 fragments, with a reduced fragmentation area of 95–96 square meters.
- RGO. Upon detonation, the grenade produces 670–700 fragments weighing 0.46 g and traveling at speeds of up to 1200 m/s. The effective fragmentation area is 213–286 square meters.



DROPPING RGD-5 FROM A HEIGHT OF 70-150 M

Types of ammunition for UAVs



The VOG-17M ammunition modification is in high demand, in which the fuse is equipped with a self-destruction device with a 25-second delay.



VOG-17 ON THE MAVIC 3 UAV

GRENADES FOR UNDERBARREL GRENADE LAUNCHERS



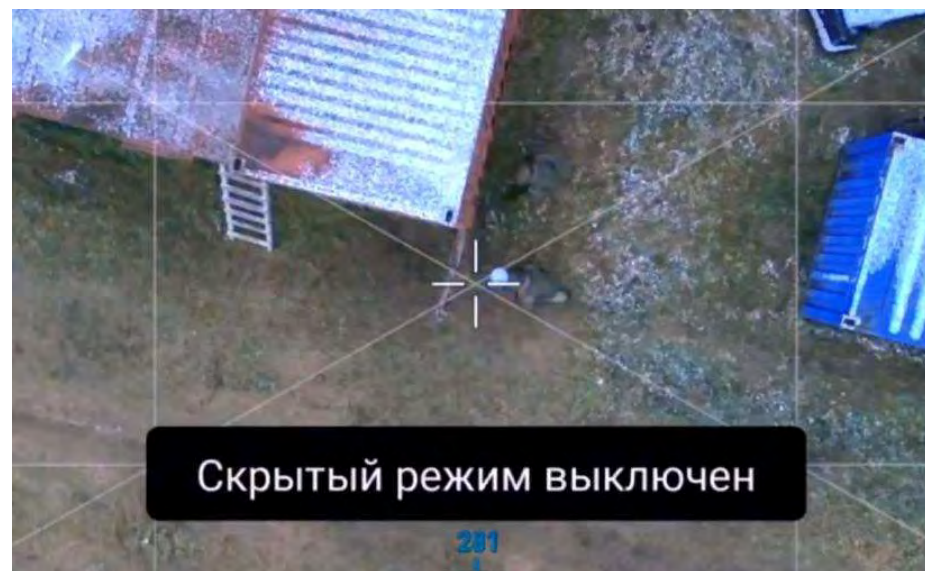
40x53 mm grenade (USA), adapted for deployment from UAVs

Types of UAV ammunit

To avoid being hit by a UAV-dropped grenade, you need to get out of the bomb drop zone as quickly as possible and leave the 10-15 meter impact zone. Move chaotically, avoiding straight lines. When the grenade explodes, lie down on the ground with your head facing away from the explosion and cover your head with your hands. After a few seconds, quickly get up and move on. Be aware of the possibility of subsequent drops!



Typical target for dropping ammunition from a UAV



Training exercises using multi-rotor UAVs

Author's comment: it should be noted that it is extremely difficult to repeatedly change body position while wearing equipment and in full gear, but standing still is not an option. + The advice to dodge and move chaotically is quite general: if possible, other fighters also start firing at the UAV

Types of UAV ammunit

DEVIATION FROM DROPPING FROM UAV

THE HIGHER THE UAV, THE LOWER THE ACCURACY OF THE DROP, AND VICE VERSA, THE LOWER IT IS, THE MORE ACCURATE AND DANGEROUS IT IS!



GRENADE DROP FROM A UAV FROM A HEIGHT OF 100-150 M



GRENADE DROP FROM A UAV FROM A HEIGHT OF 150-300 M

Types of UAV ammunition

The warhead (WH) of the PG-7V rocket is cumulative, single

Caliber — 85 mm. Direct fire range — 330 m. Penetration: armor — 260 mm, brick — 1.0 m, reinforced concrete — 0.6 m, pillbox — 1.5 m.

The PG-7V round is designed to engage armored and reinforced concrete targets. It is capable of penetrating obstacles up to

326 cm на дистанции до 330 м.



The warhead (WH) of the TBG-7V projectile is a thermobaric high-explosive grenade

Caliber: 105 mm. Weight: 4.5 kg.

Effective range (indoors): 300 m³. Effective range (depending on the launcher): up to 500 m.

Designed to suppress enemy forces in open terrain, trenches, field shelters, buildings and structures of various types, lightly armored and unarmored vehicles. Provides destruction enemy forces within a radius of up to 10 m.



Author's comment: Quickly identifying the type of ammunition approaching your position is more a matter of luck; however, this information will help you avoid unnecessary losses. Thermobaric and cumulative ammunition are very different, and knowing this will allow you to respond appropriately.

PG-7V, TBG-7V warheads



PG-7V warheads mounted on IPV drones



from UAVs

Types of UAV ammunition

DEVIATION FROM THE İPV DRONE (KAMIKAZE)

IT IS STRICTLY FORBIDDEN TO STAND STILL AND WAIT FOR THE STRIKE!

INCORRECT ACTIONS – PASSIVE WAITING:



YOU MUST QUICKLY REGAIN YOUR COMPOSURE AND BEGIN AN EVASIVE MANEUVER, THEN, IF POSSIBLE, OPEN FIRE ON THE UAV WITH YOUR SMALL ARMS!



CORRECT!

Types of UAV ammunit

AMMUNITION FOR DRONES WITH INCREASED LOAD CAPACITY



RPG AND 82-MM MINE



TM-62M MINE



PTAB



HOMEMADE EXPLOSIVES



IGNITING AMMUNITION



82-mm MINES

Types of UAV ammunit

TM-62M is a Soviet anti-tank pressure mine. The explosion occurs when a tank track or vehicle wheel runs over the top cover of the mine. For UAVs — remote or mechanical/pulse detonation. Appearance: flat, rounded metal box. Inside the box is an explosive charge, and a fuse is installed on top.

- Body material: metal.
- Weight: 9.5–10 kg, weight of explosive: 7.5–8 kg.
- Diameter: 32 cm.
- Height: with MB-62 — 12.8 cm, with MBSH-62 — 10.2 cm.
- Target sensor diameter: 9 cm, sensitivity: 200–500 kg.

It is not possible to launch an aircraft-type UAV (e.g., Molniya-2) with TM-62M from the ground, so it can be launched from a height (building) and then glide to the target.

AMMUNITION FOR DRONES WITH INCREASED LOAD CAPACITY



TM-62M mine prepared for use with UAVs
Molniya

Types of UAV ammunition

The Ukrainian military uses chemical ammunition for UAVs.

In early April 2023, a Mavic-3 UAV equipped with a Teren-6 gas grenade manufactured by NPP Ekolog (Kyiv) was intercepted at Russian Armed Forces positions in the Pervomaisky district (DPR). The munition was loaded with a mixture of CS irritant and pelargonic acid morpholide.

Also, in mid-June 2023, the Armed Forces of Ukraine used a kamikaze UAV with a plastic container without an explosive device containing a toxic substance against Russian Armed Forces positions in the area of Rabotino, Zaporizhzhia region. The results of tests conducted by the Russian Ministry of Defense laboratory (Melitopol) showed the presence of chloroacetophenone mixed with chloropicrin. Melitopol) showed the presence of chloroacetophenone mixed with chloropicrin.

The use of chemical munitions is prohibited by the international Chemical Weapons Convention (CWC).

Author's comment: such ammunition is used comprehensively, primarily against infantry in buildings and trenches — it is important to remember that if you encounter a toxic substance, you must protect your respiratory organs and leave the spray zone, as it is dangerous to enter an ambush/UAV.

CHEMICAL AMMUNITION



"Teren-6" manufactured by NPP "Ecologist"



Capacity without explosive device with toxic substance

Types of UAV ammunit

Incendiary ammunition for UAVs are thermite shells that are dropped from drones. They have a high combustion temperature (2300–2700 °C) and are capable of burning through concrete structures, metals, and equipment.

There is also a universal line of warheads for UAVs. It can be used with almost all types of UAVs used in special operations. The warheads are made in a cylindrical body, inside which the main charge and detonator are placed.

Author's comment: Such ammunition is used for the purposes of provocation/destruction of LS/camouflage and property of the unit in defense.

IGNITING AMMUNITION



USE OF A THERMITE "LIGHTER" FROM A
MULTIROTOR UAV

Types of UAV ammunit

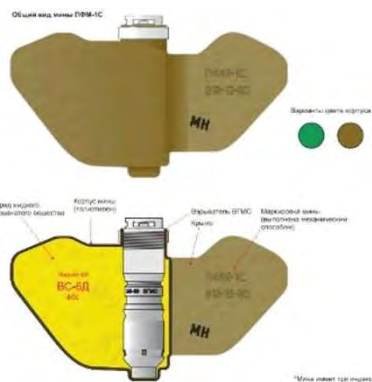
IGNITING AMMUNITION



USE OF A THERMITE "LIGHTER" WITH A UAV IN A FOREST BELT OCCUPIED BY THE ENEMY (TO DESTROY EQUIPMENT, CAMOUFLAGE, TECHNOLOGY, AND CAUSE PHYSICAL AND PSYCHOLOGICAL DAMAGE TO THE ENEMY)

Types of UAV ammunit

REMOTE MINING



PFM-1 "Lepestok" — Soviet-made anti-personnel pressure mine.

Dimensions: 119x64x20 mm, weight: 80 g, explosive charge: 37 g. Activation force: 5–25 kg. Colors: shades green, marsh, red-brown.



PFM-1 DROP CASES FOR UAV



DROPPING PFM-1 CASSETTES FROM UAV

Comment from the author: the ammunition is widely known and studied; however, we note here that the petals should be searched for within the drop radius. Do not ignore

Types of UAV ammunit

REMOTE MINING

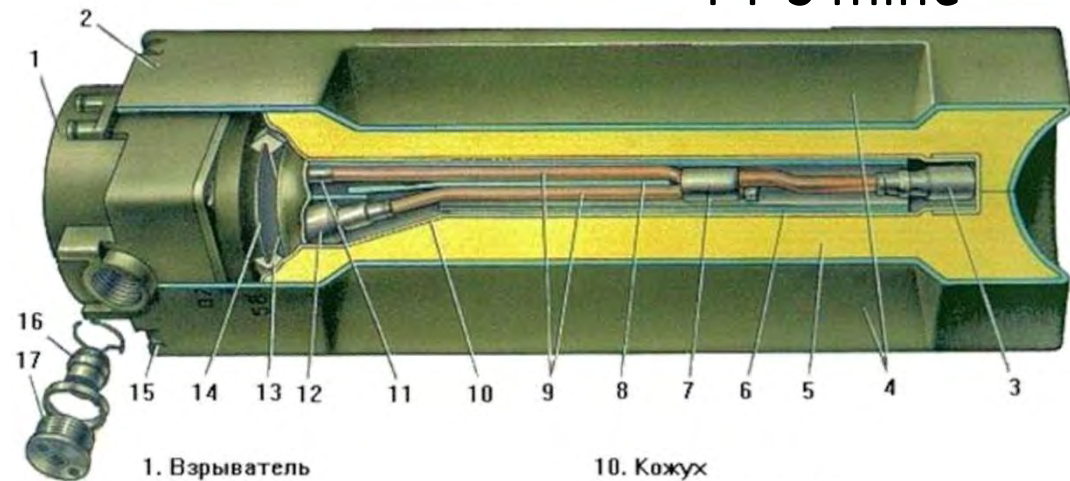
PTM-3 is a Soviet engineering munition (anti-tank mine) designed to disable enemy wheeled and tracked vehicles by destroying their running gear or hitting the bottom with a cumulative jet when the vehicle drives over or is above the mine.

- Total weight: 4.9 kg.
- Dimensions: length — 33.0 cm, width — 8.4 cm.
- Explosive: 1.8 kg (TG-40).
- Fuse: non-contact magnetic VT-06.
- Temperature range: -40...+50 °C.
- Guaranteed storage life: 10 years.



Author's comment: extremely dangerous for infantry, reacts to metal (weapons, equipment) and impulse.

PT-3 mine



- | | |
|--------------------------------|------------------------------|
| 1. Взорыватель | 10. Кожух |
| 2. Корпус | 11. Приемная шашка |
| 3. Дополнительный детонатор | 12. Дополнительный детонатор |
| 4. Кумулятивные выемки | 13. Мембрана |
| 5. Заряд ВВ (ТГ - 40) | 14. Прокладка |
| 6. Двойной металлический кожух | 15. Лапка |
| 7. Гильза | 16. Заглушка |
| 8. Пластины | 17. Источник тока |
| 9. Отрезки детонирующего шнура | [элемент РЦ-53У] |

Types of UAV ammunit

REMOTE MINING

MON-50 — anti-personnel fragmentation mine with directional effect. Designed to destroy enemy personnel, including those in trucks and passenger cars.

- Mine weight — 2 kg, charge weight (PVV-5A) — 0.7 kg;
- Number of striking elements: 485–540
- Horizontal fragmentation angle: 54°
- range of continuous damage — 50–58 meters;
- range of damage to passenger and freight vehicles and personnel inside them — up to 30 meters;
- flight range of elements — 80–85 meters.

The mine can be placed on the ground (in snow) on legs or attached to local objects with a clamp.

Author's comment: can be used in an ambush with a UAV — drone in standby mode, detonator controlled by the operator on the other side; both statically and after being lifted by the drone to a height of up to 30 m.



MON-50 (100)

Types of UAV ammunit

REMOTE MINING

CAMOUFLAGE OF MINES DROPPED FROM UAVs:



PT-3 mines in camouflage covers found on roads

Types of UAV ammunit

REMOTE MINING

CAMOUFLAGING MINES DROPPED FROM UAVs:

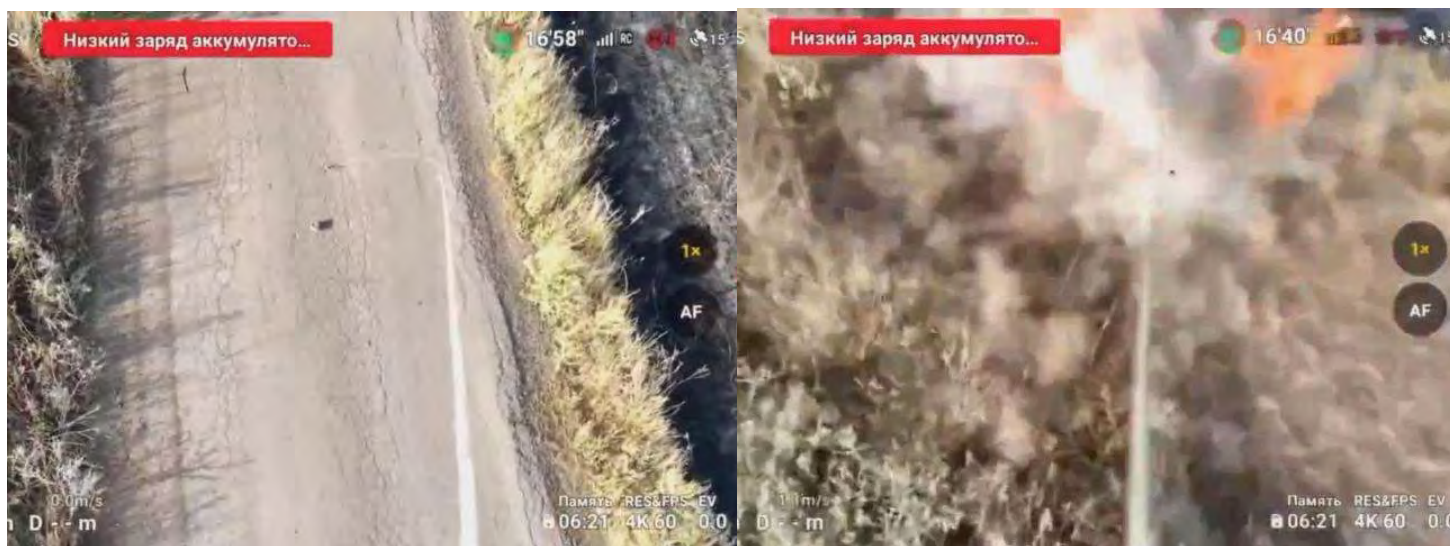


Author's comment: First and foremost, it is the "objects of interest" that are dangerous, not just mines disguised as snags and debris. A good rule of thumb:
"If you didn't put it there, don't pick it up; if you didn't put it there, don't take it away!"

Types of UAV ammunit

REMOTE MINING

Comment from the author: The illustrations show alternative methods of clearing ammunition dropped from UAVs – remember that clearing ammunition yourself is extremely dangerous! It is always better to entrust this to a specialist and notify your commander and comrades. As a last resort, you can use a rope with a hook (a so-called "cat") or shoot the ammunition, but this is **EXTREMELY DANGEROUS**: you should stay as far away from the ammunition as possible, dig a single trench, and protect yourself from shrapnel within the radius of impact. Approaching and touching ammunition is prohibited.



Remote demining using UAVs



Methods of combating UAVs:

Passive defense:

- Dispersion (personnel and equipment)
- Multispectral camouflage (individual, positions, equipment) and engineering equipment of positions
- Creation of false positions

Active defense:

- Organization of air observation points and anti-UAV calculations
- Detection and suppression using radio-technical means
- Combating UAVs with small arms
- Alternative methods of suppressing UAVs