UDC 623.48:355.4


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RECOMMENDATIONS FOR THE USE OF UNMANNED FLYING DRONES AND TECHNICAL EQUIPMENT OF MULTI-PURPOSE ROBOTIZED PLATFORMS DURING THE EVACUATION OF MILITARY EQUIPMENT IN THE CONDITIONS OF HOSTILITIES

The issue of timely and high-quality restoration of samples of military equipment, maintaining them in readiness for combat use, implementation of measures to evacuate military equipment, restoration of technical readiness of samples of military equipment by carrying out appropriate types of repairs in the conditions of hostilities has been raised.

Recommendations are given regarding the use of unmanned aerial vehicles and technical means of multi-purpose robotic military equipmentduring the evacuation of military equipment in the conditions of hostilities.

Keywords: *evacuation, restoration, repair, hostilities, unmanned flying drones, multi-purpose robotic platforms.*

Statement of the problem. The experience of the Anti-Terrorist Operation (ATO), the Joint Forces Operation (JOF), and today – and the russian-ukrainian war, shows that the successful conduct of combat operations (CO) requires maintaining a certain level of combat capability of the troops (forces) by equipping them with serviceable military equipment (ME). It is obvious that the failure of ME samples in these conditions occurs both as a result of combat damage and due to operational and technical reasons caused by the increased intensity of operation of the equipment in combat conditions.

In this regard, measures that are aimed at maintaining military equipment ready for combat use by implementing measures to restore it, in particular the evacuation of ME, are gaining more and more urgent importance.

Measures to restore the ME, namely conducting technical reconnaissance and evacuation in the conditions of constant visual reconnaissance by the enemy and with the use of shock unmanned aerial vehicle (UAV), pose a danger to the calculations of repair and restoration units.

So, the transition from classic evacuation methods to the use of multipurpose robotic platforms (MRP) and UAV is a critically necessary step to preserve qualified specialists and increase the effectiveness of restoring the combat capability of the troops.

Analysis of recent research and publications. The issue of the effectiveness of the use of forces and means of repair and restoration units (RRU) in the process of evacuation of military equipment, such scientists as: B. O. Demianchuk, O. V. Huliak, D. V. Lisovenko, M. I. Shaptalenko, O. M. Vorobiov, O. I. Khazanovych and others. [1, 2]. They substantiated the main provisions, methods, techniques and models regarding the organization of restoration (repair) and evacuation military vehicles (MV). However, these models do not pay enough attention to the study of evacuation processes and their impact on recovery efficiency in general.

The purpose of the article there is a development of recommendations for the use of unmanned aerial vehicles and technical means of multi-purpose robotic platforms during the evacuation of military equipment in the conditions of hostilities.

Summary of the main material. In order to determine the exact location of the repair fund in the area, to investigate the condition of the access roads to these facilities, to choose rational ways of evacuating damaged samples MV, transportation of goods, protection of evacuation columns, detection of ambushes, it is proposed to introduce appropriate units into the staff of repair and evacuation bodies UAV and technical facilities MRP.

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For this, it is necessary to decide on the composition of these means, their characteristics and capabilities, as well as their staff purpose. It should be noted that in order to perform the functions outlined above according to the existing classification UAV the following are used: reconnaissance – are designed for obtaining intelligence information about the enemy and preparing and conducting CO; logistics – for air transportation and delivery of goods for various purposes, evacuation of the wounded [3].

Similarly, from the list of available technical means MRP we determine those intended for logistical support of units using replaceable specialized modules for transporting ammunition, weapons, equipment, fuel and lubricants [4].

Structurally MRP are combine several functions (support complexes) and are self-propelled remotely controlled means that can be equipped with weapons, technical means of reconnaissance of the enemy and the terrain, a set of replaceable working equipment and tools depending on the task [5].

It should be noted that the conduct of the russian-ukrainian war, as well as the recent hostilities between Azerbaijan and Armenia, is distinguished by the use of kamikaze drones and other UAV for reconnaissance, which had a significant impact on the course of the conflict [3, 6].

In this regard, one of the improved ways of determining the exact location of the repair fund in the area, of scouting the state of access roads to these facilities, of determining rational ways of evacuating damaged MV samples, of transporting goods, of guarding evacuation convoys and of detecting ambushes is the widespread use of UAV in the interests of the repair and evacuation bodies of units of the Ukrainian Defense Forces (Figure 1).

In order to effectively monitor the terrain, it is advisable to equip the repair and evacuation body with a reconnaissance vehicle on a tracked or wheeled armored base, which has on board a set of UAV class "tactical battlefields" with the following main characteristics: weight – up to 50 kg; flight height – up to 3 km; range of application (control radius) – up to 40 km; duration of stay in the air – 8 – 10 hours; the number of simultaneously piloted aircraft is – 2 units; the possibility of control from the ground and from the side of the machine; target load – video camera, thermal imaging camera, navigator, designed for the use of the GPS.

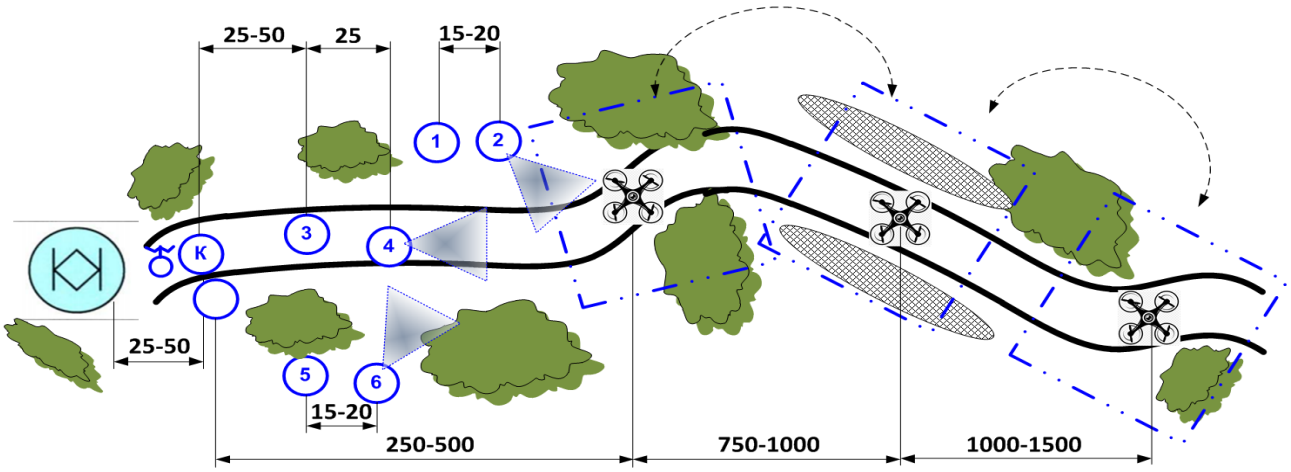

Figure 1 – Schematic of the application of a tactical unmanned aerial vehicle of the battlefield (option): 1, 2, 3, 4, 5, 6 – calculation numbers; K – commander of the UAV unit [7]

Consequently, the above-mentioned requirements determining the composition and equipment of the repair and evacuation authorities, the procedure and methods for establishing the exact location of the repair fund on the ground, the reconnaissance of the condition of the access roads to these facilities, rational ways of evacuating damaged MV samples, as well as the organization of cargo transportation and the protection of evacuation convoys, taking into account the experience of the russian-ukrainian war, will make it possible to significantly increase the successful performance of tasks.

Therefore, the presence of linear and point objects on traffic routes will be the initial data for the development of a cyclogram of movement during the conduct of technical reconnaissance by repair and evacuation bodies (Figure 2).

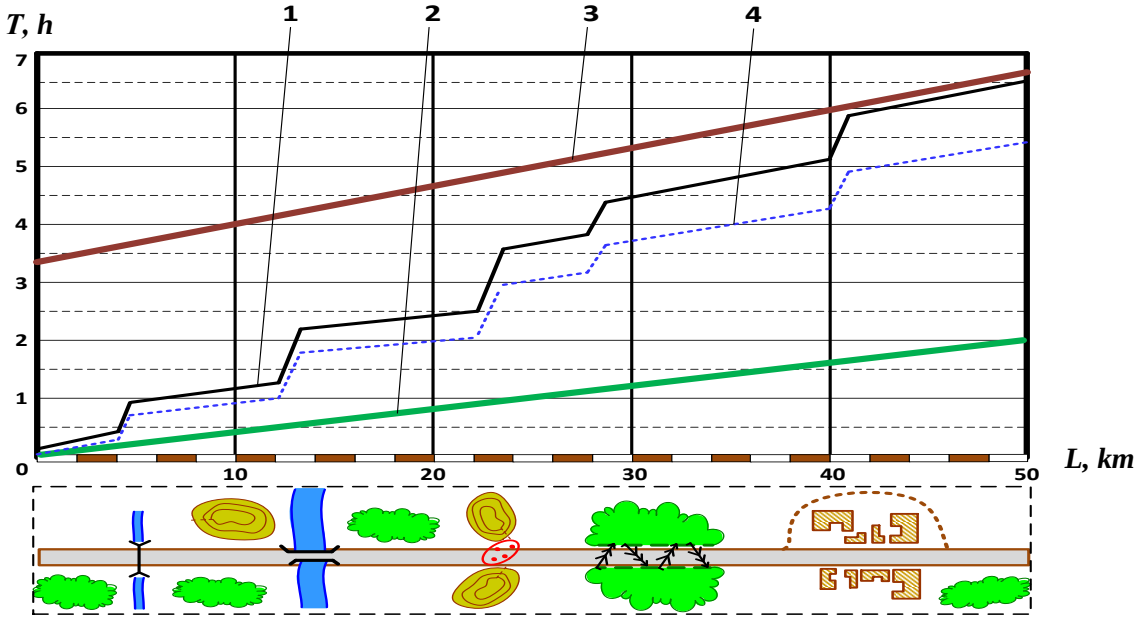

Figure 2 – Cyclogram of movement of repair and evacuation bodies:
1 – schedule of technical reconnaissance and evacuation of damaged MV samples "by classical" methods;
2 – schedule of evacuation of damaged MV samples without enemy influence on evacuation routes;
3 – schedule of evacuation of damaged MV samples after restoration of evacuation routes in case of their destruction; 4 – schedule of technical reconnaissance and evacuation of damaged MV samples by repair and evacuation authorities "in an improved " way (option) [7]

With the help of a cyclogram, operational data are obtained regarding the total time of delay in the evacuation of damaged MV samples, as well as the necessary time for the implementation of technical reconnaissance measures and the evacuation of damaged MV samples by the repair and evacuation authorities. This is a valid basis for determining not only the tasks, composition of forces and means, RRU, but also taking into account the use of UAV units and technical means of MRP during technical reconnaissance and evacuation of damaged MV samples by repair and evacuation bodies.

The choice of means of transportation will depend on the conditions of the area, type and place of hostilities, subordination and according to the type of units that ensure the evacuation of damaged MV samples, can be carried out on APCs, IFVs or on an off-road vehicle.

However, the hybridity of conducting a modern armed confrontation expands the range of tasks (measures) that also rely on repair and evacuation bodies, the main of which is the creation of safe and unhindered conditions for conducting technical reconnaissance and carrying out the evacuation of damaged MV samples.

For effective technical reconnaissance and evacuation of damaged samples of military equipment, the available methods of their implementation should be based on trends in the direction of process robotization, taking into account the wide possibilities for increasing the efficiency of technical reconnaissance and evacuation of damaged samples of MV, which will determine the technical equipment of repair and evacuation bodies and will additionally contain:

– a mobile robotic complex based on UAV for conducting technical reconnaissance, protecting evacuation columns, detecting ambushes and remotely destroying them;

– reconnaissance UAVs (drones of the micro, mini type) of rapid deployment (for conducting technical reconnaissance at low altitudes and at different times of the day);

– MRP for logistics support of units using replaceable specialized modules for transporting ammunition, weapons, equipment, fuel and lubricants and logistics.

Therefore, modern ways of improving technical reconnaissance and evacuation of damaged MV samples are a combination of air-ground methods, which will be based on the use of the capabilities of modern means of robotic systems, UAVs, etc.

In general, unmanned aviation systems (UAS) they are divided into three main classes depending on the characteristics of the UAV included in their composition (Table 1).

Table 1 – Classification of UAV from the composition of UAS

<table>
<tr><td rowspan="2">Type</td><td colspan="3">Characteristics UAV, which are part of UAS</td><td rowspan="2">Category UAV of NATO member states</td></tr>
<tr><td>Takeoff weight</td><td colspan="2">Application level</td><td>Combat range</td></tr>
<tr><td rowspan="3">I</td><td>to 2 kg</td><td rowspan="3">tactical</td><td>Micro</td><td>to 5 km</td><td>Micro</td></tr>
<tr><td>from 2 kg up to 15 kg</td><td>Mini (battlefield)</td><td>More than 5 km</td><td>Mini</td></tr>
<tr><td>from 15 kg to 150 kg</td><td>Small</td><td>More than 25 km</td><td>Small</td></tr>
<tr><td>II</td><td>from 150 kg to 600 kg</td><td colspan="2">Tactical (operational-tactical)</td><td>More than 50 km</td><td>Tactical</td></tr>
<tr><td rowspan="2">III</td><td rowspan="2">over 600 kg</td><td colspan="2">Operational</td><td rowspan="2">Operational, more than 200 km (out of direct radio visibility)</td><td>MALE</td></tr>
<tr><td colspan="2">Strategic</td><td>HALE</td></tr>
</table>

According to the experience of use, modern UAV can have characteristics that correspond to different classes. In this case, the UAV class is determined by the one of its characteristics that has the smallest value.

Unmanned aerial vehicles from the first type UAV usually do not require special take-off platforms, they are launched from the hand (or with the help of a catapult) and are used at altitudes up to 1500 m.

Battalions (companies, platoons) UAS, those who will work in the interests of repair and evacuation bodies are mainly equipped the first type UAV and designed to perform tasks at tactical depth.

At the same time, units that are equipped the first type UAV (small tactical), are mainly intended for the performance of tactical tasks in the interests of the operational-strategic grouping of troops, flotillas, brigades (regiments), coastal missile forces and divisions of support ships (vessels), a separate reconnaissance battalion, brigade artillery, battalions of the first echelon.

The main tasks of battalions (companies, platoons) UAS, which apply the first type UAV to increase the efficiency of technical reconnaissance and evacuation of damaged MV samples, there are: obtaining intelligence information about the area, meteorological conditions (weather), soil condition in the areas of evacuation of damaged MV samples; transportation of goods necessary for the evacuation of damaged MV samples; protection of evacuation columns, detection of ambushes.

Special flight is a flight UAV to perform tasks without the use of means of destruction (with the exception of means of destruction used for remote mining) both independently and in interaction (jointly) with manned aircraft. Special flights can also be performed to solve the above tasks.

A special flight to protect evacuation columns, detection of ambushes can be carried out in the following ways:

1) on duty in a certain area (usually used to control the situation that has developed on the traffic route and the adjacent territory, water area);

2) by flying around the route of the evacuation columns (usually used to control the situation that has developed on the route and the adjacent territory, water area).

Conclusions

Therefore, the implementation of recommendations for the use of unmanned aerial vehicles and technical means of multi-purpose robotic platforms during the evacuation of samples of military equipment in the conditions of hostilities will make it possible to more accurately determine:

– placement of the repair fund on the ground;

– remotely assess the condition of damaged equipment, necessary tools and scope of work;

– condition of access roads to damaged machinery (presence of mine-explosive, non-explosive barriers, ambushes, condition of road surface);

– more rational ways of evacuating damaged samples of military equipment, transporting goods, as well as guarding evacuation columns and detecting ambushes in time.

These measures will make it possible to increase the safety of the personnel of repair and restoration units and the success of their tasks to restore damaged (stuck) weapons and military equipment.

The direction of further research will be the substantiation of the technical features of samples of multi-purpose robotic platforms for conducting technical reconnaissance of damaged military equipment and its evacuation in the conditions of hostilities.

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The article was submitted to the editorial office 16.03.2026
Accepted for publication after peer review 12.04.2026
Publication date 29.05.2026

УДК 623.48:355.4

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РЕКОМЕНДАЦІЇ ЩОДО ЗАСТОСУВАННЯ БЕЗПІЛОТНИХ ЛІТАЛЬНИХ АПАРАТІВ ТА ТЕХНІЧНИХ ЗАСОБІВ БАГАТОЦІЛЬОВИХ РОБОТИЗОВАНИХ ПЛАТФОРМ ПІД ЧАС ЕВАКУАЦІЇ ВІЙСЬКОВОЇ ТЕХНІКИ В УМОВАХ ВЕДЕННЯ БОЙОВИХ ДІЙ

Зміна характеру й умов ведення бойових дій в сучасних умовах тісно пов'язана зі зростанням можливостей зразків озброєння та військової техніки, а також новітніх технологій, що обумовлюють пошук шляхів зменшення втрат серед особового складу. На сьогодні активно проводиться робота щодо розвитку і практичного застосування багатоцільових роботизованих платформ та безпілотних літальних апаратів для виконання різнопланових завдань у військовій сфері.

Вирішення цих питань впливає на поступове нарощення спроможностей ремонтно-відновлювальних підрозділів Збройних Сил України під час виконання бойових (спеціальних) завдань в умовах ведення бойових дій. Реалізація ідеї застосування багатоцільових роботизованих платформ (БРП) та безпілотних літальних апаратів (БпЛА) з метою відновлення озброєння та військової техніки дасть змогу зменшити втрати серед особового складу та сягнути рівня спроможностей ремонтно-відновлювальних підрозділів, якого неможливо досягнути наявними розрахунками.

Своєчасне і якісне відновлення зразків військової техніки, підтримання її в готовності до бойового застосування, виконання заходів щодо технічної розвідки, евакуації, проведення відповідних видів ремонту в умовах ведення бойових дій безпосередньо впливає на комплектування військової техніки та спроможності підрозділів сухопутних військ Збройних Сил України на виконання завдань за призначенням.

Виконання завдань щодо евакуації військової техніки у процесі відновлення її технічної готовності в сучасних умовах стає дедалі більш нагальним і актуальним у зв'язку зі складністю виконання зазначеного вище завдання та ризиками для життя і здоров'я особового складу.

Також визначений у праці порядок застосування БРП і БпЛА не є вичерпаним і може бути доповнений внаслідок постійного розвитку науки, озброєння і військової техніки та технологій. Напрямом подальших досліджень буде обґрунтування технічних особливостей зразків БРП для проведення технічної розвідки пошкодженої військової техніки та її евакуації в умовах ведення бойових дій.

У статті подано рекомендації щодо застосування БпЛА та технічних засобів БРП під час евакуації військової техніки в умовах ведення бойових дій.

Ключові слова: *евакуація, відновлення, ремонт, бойові дії, безпілотні літальні апарати, багатоцільові роботизовані платформи.*

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