

## AN OVERVIEW OF THE MOST EFFECTIVE TECHNICAL MEANS USED FOR VARIOUS MILITARY ENGINEERING MISSION, WITH HIGHLIGHTS ON THEIR INTEROPERABILITY

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**Abstract:** We could mention that currently we cannot speak, at the level of the NATO Alliance, of the existence of interoperability of engineering structures, from all partner armies, in terms of providing them with high-performance technical means, intended to ensure timely and efficient engineering support. This is based on the analysis we carried out on ensuring the interoperability of engineering structures participating in multinational missions and exercises, from the perspective of providing them with modern technical means, in order to fulfill the engineering support missions, after some exchanges with partners from Hungary, the Czech Republic, Slovakia and the multinational exercises that colonel Mircea VLADU led as director or co-director, between 2011 and 2013 in Romania, Hungary and Croatia. On these occasions, we were able to ascertain that the engineering structures of the armies that were part of the Warsaw Treaty are predominantly equipped with technical engineering means from the 80s, some purchased from the former USSR and others manufactured within their own defense industries, a situation that continued even after the integration of the respective states into NATO, as a result of the allocation of some percentages of the GDP, below the level of the commitments and at the same time the support with insufficient funds of the endowment proposals with efficient means, according to NATO standards. Considering these elements, we would like to further present some considerations aimed at equipping NATO engineering structures with the most efficient technical means for the execution of engineering research operations.

**Keywords:** interoperability, engineering support, NATO standards, efficient technical means, notions of endowment

### 1. Introduction

Through this article, we did not intend to present the endowment of the engineering structures of all NATO member armies and to highlight which structures are endowed with high-performance technical means and which have less high-performance technical means. Instead, we set out to present, with arguments, aspects of the technical engineering means intended to fulfill the missions/tasks of engineering support aimed at the execution of engineering reconnaissance of the enemy and the

terrain, mine verification, demining the terrain and objectives and making lanes through the enemy's explosive and non-explosive barrages, in all types of operations, which we consider to be the most effective and which we recommend to be introduced in the endowment of the engineering forces of the NATO member armies, which currently do not have them and which would contribute to the achievement of the desired interoperability.

## 2. High-Performance Technical Means Used Worldwide/in NATO for Various Engineering Support Missions

### 2.1. High-Performance Technical Means Recommended for Executing Engineering Reconnaissance of the Enemy and the Terrain

In our opinion, the most efficient technical

means intended for the execution of intelligence research of the enemy and the terrain, by the specialized engineering structures, from the most modern armies of the North Atlantic Treaty are: *Saladin*, *Scorpion* and *Ferret*, whose technical-tactical characteristics are presented in Table 1.

Table 1 The technical-tactical characteristic of the most efficient types of technical means, intended for engineering research of the enemy and the terrain [1]

| Tactical-technical characteristics   | The most efficient technical means intended for the execution of engineering research of the enemy and the terrain |                                                                                                                           |                                                                                                        |
|--------------------------------------|--------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|
|                                      | SCORPION-101 [1]                                                                                                   | SALADIN [1]                                                                                                               | FERRET [1]                                                                                             |
| The year of entry into the endowment | 1990                                                                                                               | 1950                                                                                                                      | 1952                                                                                                   |
| Autonomy                             | approx. 800km                                                                                                      | approx. 400 km                                                                                                            | approx. 300km                                                                                          |
| Engine type                          | Jaguar J60 of 4.2 l., with 6 cylinders on petrol, which produces 190 hp. at 4750 [RPM];                            | Rolls -ROYCE B80 MK 6A, with 8 cylinders, on gasoline, with coolant, producing 170 hp. at 3750 [RPM];                     | Rolls -ROYCE B60 MK 6A, with 6 cylinders on gasoline with coolant that produces 129 hp, at 3750 [RPM]; |
| Full speed                           | 80,5km/h                                                                                                           | 72km/h                                                                                                                    | 93km/h                                                                                                 |
| Fuel tank capacity                   | 420 l diesel                                                                                                       | 200l gasoline                                                                                                             | 96l gasoline                                                                                           |
| Types of armaments on board          | Main gun 76 mm caliber; 7.62 mm coaxial machine gun; 2x4 grenade/smoke launchers.                                  | Main gun 76 mm caliber; 7.62 mm caliber coaxial machine gun; 7.62 anti-aircraft machine gun; 2x6 grenade/smoke launchers; | 7.62mm caliber machine gun and 2x3 grenade/smoke launchers;                                            |
| Maximum weight                       | 8,073t                                                                                                             | 11,59 t                                                                                                                   | 4,4t                                                                                                   |
| The length of the technical means    | 4,794m                                                                                                             | 4.93 m without the gun or 5.284 m with the gun barrel pointing forward                                                    | 3,85m                                                                                                  |
| The width of the technical means     | 2,235m                                                                                                             | 2,54m                                                                                                                     | 1,905m                                                                                                 |
| The height of the technical means    | 2,102m                                                                                                             | 2,39 m                                                                                                                    | 1,879m                                                                                                 |
| Armor thickness                      | 16mm                                                                                                               | 32 mm                                                                                                                     | 16mm                                                                                                   |
| Crew composition                     | 3 persons                                                                                                          | 3 persons                                                                                                                 | 3 persons                                                                                              |

From the analysis of the technical- tactical characteristics presented in Table 1, in our opinion, the best performing technical mean intended for engineering research of the enemy and the terrain, which we would recommend for the endowment of all the engineering research structures of the enemy and the terrain, from the composition of all the specialized structures of the NATO member armies, is the technical mean called *SCORPION* or *FV101*. To support the recommendations, we present the following arguments [1]: it

is the newest technical mean (entered in 1990); has the greatest autonomy (810 km); has the most powerful engine (190 HP); has the largest fuel tank capacity (420 l diesel). For edification, Figure 1 shows the image of the technical mean - Scorpion, an amphibious vehicle, propelled by its own tracks and made in the variants: Scorpion 90; Spartan; Stormer; streaker; Stricker; Samson; Sultan, Samaritan; Scimitar; Saber:



Figure 1: *SCORPION*

## 2.2. High-Performance Technical Means Recommended for Mining Verification, Land and Objective Demining

The engineering structures specialized in mine verification, terrain and objective demining, from the composition of modern NATO member armies, are equipped, as appropriate, with the HUNTER remote-controlled robot, the MD-8 portable mine detector, the ATMID mine detector, the Dragon Runner robot, etc.

From the point of view of ensuring interoperability, under the aspect of endowment of specialized NATO

engineering structures, in order to check mines, demining the land and objectives, the NATO standard is not ensured.

For argumentation, in Table 2, we present a comparative analysis of the previously highlighted technical means, on the basis of which the conclusion can be drawn, according to our opinion, which is the most efficient technical mean, that can enter the endowment of all the specialized engineering forces of NATO, contributing to ensuring the fulfillment of the desired interoperability.

*Table 2 The technical- tactical characteristics of the most efficient types of technical means, intended for mine verification, demining of land and objectives, according to NATO standards [1]*

| <b>Types of technical means intended for mining verification, land and objective demining</b> | <b>Technical- tactical characteristics</b>                                                                                                                                                                                                                                                                                                                                            |
|-----------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Remote controlled robot HUNTER [1]                                                            | It is self-propelled with the help of tires or tracks; it has two video surveillance cameras and means of fire for self-defense; it is able to perform research-demining missions, application of explosive charges.                                                                                                                                                                  |
| MD-8 Portable Mine Detector [1]                                                               | It has high metal detection sensitivity (0.05g steel at a depth of 75 mm); it is based on the technology of high-frequency electromagnetic pulses; it is resistant to humidity, being able to be used successfully in water up to a depth of 2m and at temperatures between -25 and +70°C; the high degree of automation determines that its use requires a very short training time. |
| ATMID mine detector [1]                                                                       | It has a high metal detection sensitivity; can detect mines, including those with a very low metal content, buried in all types of terrain and / or fresh or salt water; the optimal working temperature is -40 and +70°C; the working autonomy is approximately 70 hours (at +20°C).                                                                                                 |

| Types of technical means intended for mining verification, land and objective demining | Technical- tactical characteristics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|----------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Dragon Runner Robot [1]                                                                | <p>Detects, defuses and neutralizes bombs in particular; it is a transportable robot on the back, with possibilities of action on various types of surfaces; detects a wide variety of explosive devices without endangering the operator handling it; was included in the urgent Operational Requirements of the Romanian Army and sent to Afghanistan to support the actions of EOD specialists; it is very maneuverable and able to dig around suspicious objects, then pick them up and move them to another place; emplaces smaller explosive charges to destroy IEDs; cuts the wires of the IEDs thus rendering them inoperable; captures and transmits video images to its operator at a safe distance, enabling its own forces, in action, to assess the situation before continuing the action without major risks; tracks can be attached to it instead of wheels, thus being able to cross surfaces in medium rough terrain.</p> |

Following the analysis carried out on the technical- tactical characteristics of the technical means presented in Table 2, we consider that for the verification of mining, mining the terrain and the objectives, the most efficient technical mean that lends itself to be introduced in the endowment of

all engineering structures in the composition of the armies of the NATO member states, is the Dragon Runner robot. For a better exemplification, Figure 2 shows the image of the proposed technical mean the Dragon Runner Robot.



Figure 2: Dragon Runner Robot [2]

### 2.3. High-Performance Technical Systems Recommended for Creating Lanes through the Enemy's Explosive and Non-Explosive Barrages

The specialized engineering structures of the modern armies, members of NATO, can create lanes through the explosive and non-explosive engineering barrages of the enemy, having, as the case may be, various improved or ultra-improved systems, but which do not ensure the fulfillment of the desired interoperability, since they are not found in the endowment of all NATO engineering structures. In our opinion, among the best performing systems there are: TAMGEC portable demining system; MICLIC System (USA); MK155 Mine

Clearance Launcher; HYDREMA 910MCV demining system; KEILER demining system; KEILER demining system; Pearson C/FWMP Demining System; Wide demining plow; The SMP type plow.

As a result, in order to establish the most efficient technical system for the execution of lanes through the enemy's explosive and non-explosive barrages, with which all NATO engineering structures, specialized in order to fulfill such missions, should be equipped, we present in Table 3, for analysis, the composing characteristics of the most perfected specific technical systems, available in the endowment.

*Table 3 The tactical-technical characteristics of the most efficient technical systems, intended for execution of lanes through the enemy's explosive and non-explosive barrages, according to NATO standards*

| <b>Types of modern technical means intended for the execution of lanes through explosive and non-explosive engineering dams</b> | <b>Tactical-technical characteristics</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|---------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| TAMGEC Portable Demining System [1]                                                                                             | It has a launcher, an anchor system, a charge of 30 kg of C.4 plastic explosive and a launcher with a maximum range of 90 m; demines a corridor with a length of 55 m and a width of 0.4 m, the transport can be carried out by 2 soldiers; its commissioning can be done by a single operator.                                                                                                                                                                                                                                           |
| MICLIC System (USA) [1]                                                                                                         | The system is transported with a semi-trailer towed by M113, Bradley IFV, M 9 ACE, Leopard 1 or BV 206 tanks; the work performance consists in creating a corridor with a length of 100 m and a width of 8 m, for the passage of tanks, vehicles and personnel through the anti-armor and anti-personnel minefields, using a linear explosive charge (C 4), transported inside the minefield with the help of a rocket, taking as a safety measure the provision of a distance of 62 m between the launch point and the detonation point; |

| Types of modern technical means intended for the execution of lanes through explosive and non-explosive engineering dams | Tactical-technical characteristics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|--------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| MK155 Mine Clearance Launcher [4]                                                                                        | Represents a flexible charge launcher for demining; it is arranged on an M353 type trailer, of 3.5 t, equipped with two wheels; the payload and launch system weigh 2.83 t.                                                                                                                                                                                                                                                                                                                                                       |
| HYDREMA 910MCV demining system [3]                                                                                       | It can destroy anti-personnel and anti-armor mines with the help of rotating chains; it is placed on a 10t HYDREMA 910 truck, whose cabin is protected against light weapons of caliber up to 7.62mm; has a weight of approx. 18t and the possibility to execute a 3.5 m wide corridor.                                                                                                                                                                                                                                           |
| KEILER demining system [1]                                                                                               | It has as its base vehicle the modified M48A2 tank; executes a corridor of 4.7 m wide, at a maximum demining depth of 25 cm; it has 24 rotating chains, whose role is to hit the ground in front of the machine at a speed of 320-400 revolutions/minute; it can demine 0.2 – 0.4 km <sup>2</sup> / hour.                                                                                                                                                                                                                         |
| Pearson C/FWMP Demining System [1]                                                                                       | It is mounted on a Caterpillar D9 heavy bulldozer; can carry out demining operations without being led by a driver mechanic, because the command is ensured from a distance of at most 3 km with the help of the video link; it has a DEMETER type device that recognizes the footprint of mines and activates the magnetic mines located in the direction of movement of the vehicle, in front of it at a distance of 5-6m; creates a lane with a width of 4.2 m and a depth of 0.3 m, at a travel speed of no more than 3 km/h. |
| Wide demining plow [1]                                                                                                   | Placed on any tank chassis or on a UDK-1 type combat bulldozer, or on an AMX30B2 type tank; creates an aisle with a width of 4.2 m; it has a working speed of 80m/min at a demining depth of 20 cm.                                                                                                                                                                                                                                                                                                                               |

| Types of modern technical means intended for the execution of lanes through explosive and non-explosive engineering dams | Tactical-technical characteristics                                                                                                                                                                                                                                 |
|--------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SMP type plow [1]                                                                                                        | It is presented in the form of the letter V; it has blades and sections with which it can remove the mines in front of the 4x4 truck or battle tank that is in the direction of advance in the mined area; it can be optionally completed with the DEMETER system. |

Following the analysis carried out on the technical-tactical characteristics of the technical systems presented in Table. 3, we believe that for the execution of passages through the enemy's explosive and non-explosive barrages, the most efficient technical system, ready to be introduced in the endowment of all the engineering structures of the NATO member states' armies, is the MICLIC System (USA). In

support of our proposals, we bring the following arguments: the means of transport of the system can be towed by several types of high-performance tanks; the C4 linear explosive charge is launched into the minefield by means of a rocket; runs a lane 100 m long and 8 m wide. For exemplification, Figure 3 shows the image of the proposed technical system.

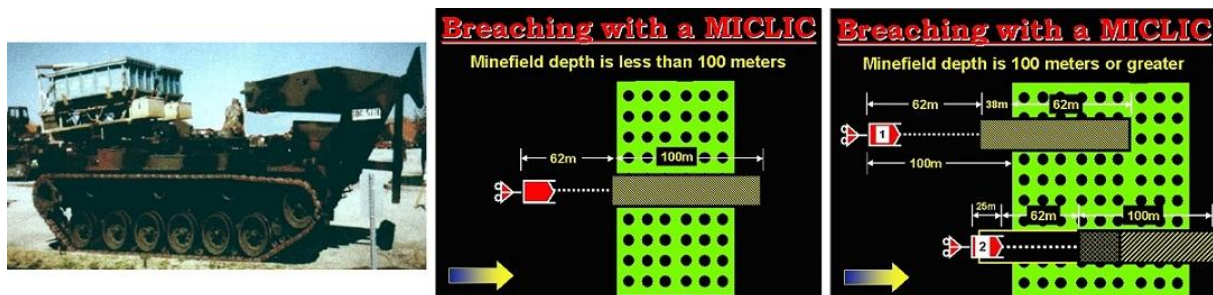


Figure 3: MICLIC System (USA) [1]

### 3. Conclusions

The lessons learned, resulting from the conduct of multinational missions and armed conflicts, have highlighted the very important role played by engineering forces in ensuring timely and effective support to maneuver forces, during the preparation and conduct of operations of all types. At the same time, the lessons learned also highlighted the fact that under the aspect of the technical endowment of engineering forces, the desired interoperability was not fulfilled, a fact that stuck on their generation and regeneration, in crisis situations. As a result, in order to fulfill the desired interoperability, we found it

necessary to carry out a comparative analysis of the most efficient technical means of the modern NATO armies. For the timely and efficient fulfillment of the engineering support missions/tasks, aiming at the engineering reconnaissance of the enemy and the terrain, checking the mine, demining the terrain and the objectives and executing the lanes through the enemy's explosive and non-explosive engineering barrages. Following that in the future we will address the issue of interoperability also from the perspective of the other missions / tasks of the engineering support.



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