Shelling of the center of Belgorod using 122-mm MLRS

Donetsk 20.03.2024

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CONTENT

ABBREVIATIONS

RF AF - Russian Federation Armed Forces

UAF - Ukrainian Armed Forces

EMERCOM - Emergency Control Ministry

MLRS - Multiple Launch Rocket System

EMW - electromagnetic warfare

UAF - Ukrainian Armed Formations

PREAMBLE

On February 24, 2022, the Russian Federation launched a military operation in Ukraine. Vladimir Putin called its goal "to protect people who have been subjected to genocide by the Kyiv regime for eight years"[1]. According to the Minister of Defense of the Russian Federation, as of July 03, through the efforts of the Armed Forces of the Russian Federation, the LPR and the DPR, the entire territory of the LPR was liberated, which was one of the primary tasks of the SMO.[2] However, part of the DPR territory was still under the control of the Ukrainian security forces.

November 2023 saw the end of the unsuccessful offensive attempt by the Ukrainian armed formations (UVF), which began on June 4[3]. The initiative on the battlefield passed to the armed forces of the Russian Federation.

On December 29, the Aerospace Forces of the Russian Federation launched the most massive attack in 2023 on the military and military-industrial infrastructure of Ukraine.[4]

On December 30, 2023, residential areas of the city of Belgorod were subjected to artillery shelling by Ukrainian armed formations (hereinafter referred to as UAF) throughout the day.

The most tragic incident occurred around 15:00[5]. The center of Belgorod came under shelling. As a result of the incident, 25 civilians (including 5 children) were killed and 109 civilians were injured[6].

To date, the names of 24 victims have been made publicly available:

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[1] Message of the President of the Russian Federation (published on 24.02.2022) Official website of the President of the Russian Federation URL: http://kremlin.ru/events/president/news/67843/videos (accessed on 06.07.2022)

[2] Russia claims key city in punishing conquest of eastern Ukraine (published on 03.07.2022) The Washington Post URL: https://www.washingtonpost.com/world/2022/07/03/lysychansk-luhansk-russia-ukraine-war/ (accessed on 06.07.2022)

[3] Ukraine's counter-attack (2023) (last updated on 04.12.2023) WikipediA The Free Encyclopedia URL: https://ru.wikipedia.org/wiki/Контрнаступление_Украины_(2023)#cite_note-2 (accessed on 14.12.2023)

[4] Russia Pounds Ukrainian Cities in One of the Largest Air Attacks of the War. The New York Times URL: https://www.nytimes.com/2023/12/29/world/europe/russia-ukraine-missile-attacks.html (accessed on 16.05.2024)

[5] The moment the incoming rocket strike in the center of Belgorod. (published on 30.12.2024) Radar Belgorod Telegram Channel. URL: https://t.me/radarbel31/440 (accessed on 14.12.2023)

[6] To our great sorrow, the number of residents killed during the shelling of Belgorod on December 30 has increased (published on 01.01.2024) Real Gladkov Telegram Channel. URL: https://t.me/vvgladkov/4425 (accessed on 16.05.2024)

1. Alexandra Lycheva, 30 years old;
2. Svetlana Vladimirovna Gaidukova, 49 years old;
3. Olga Viktorovna Fedrunova, 63 years old;
4. Maya Borisovna Zharkova, 66 years old;
5. Victoria Velichko (Potryasaeva), 35 years old;
6. Dmitry Ryapolov, 35 years old;
7. Nadezhda Ryapolova, 32 years old;
8. German Ryapolov, 1 years old;
9. Andrey Laptev, 37 years old;
10. Mikhail Ivankiv, 22 years old;
11. Mikhail Yuryevich Konopitsin, 27 years old;
12. Yulia Medvedeva, 43 years old;
13. Anastasia Medvedeva, 6 years old;
14. Nadezhda Nesvetaeva, 67 years old;
15. Valeria Giryavaya, 23 years old;
16. Yuliana Perezolova, 29 years old;
17. Yaroslav Perezolov, 7 years old;
18. Alexey Zhigalov, 29 years old;
19. Natalya Chebunina, 44 years old;
20. Alexander Andreevich Yarovoy, 73 years old;
21. Yuri Evgenievich Zhidkov, 63 years old;
22. Eva Zvereva, 4 years old;
23. Alexander Aladyin, 39 years old;
24. Mikhail Prisadov, 35 years old.[7]
25. A four-year-old girl died in hospital on January 1, 2024[8].

[7] One unknown: the names of 24 of the 25 killed during the shelling of Belgorod on December 30 have been named. BEL.RU URL: https://bel.ru/news/2024-01-06/odin-neizvestnyy-nazvany-imena-24-iz-25-pogibshih-pri-obstrele-belgoroda-30-dekabrya-3146446?ysclid=lvwassazzl371454375 (accessed on 16.05.2024)

[8] A four-year-old girl died in hospital after the shelling of Belgorod on December 30 (published on 01.01.2024) Komsomolskaya Pravda. URL: https://www.bel.kp.ru/daily/27550/4874349/https://www.bel.kp.ru/daily/27550/4874349/?ysclid=lw7kmny0xt612438644 (accessed on 16.05.2024)

INCIDENT LOCATION

Having examined the incident location, studied photos and video materials from open sources, and also talked with eyewitnesses of the incident, we recorded 17 shells hits. All of them have been explored and mapped using the Yandex Maps service.

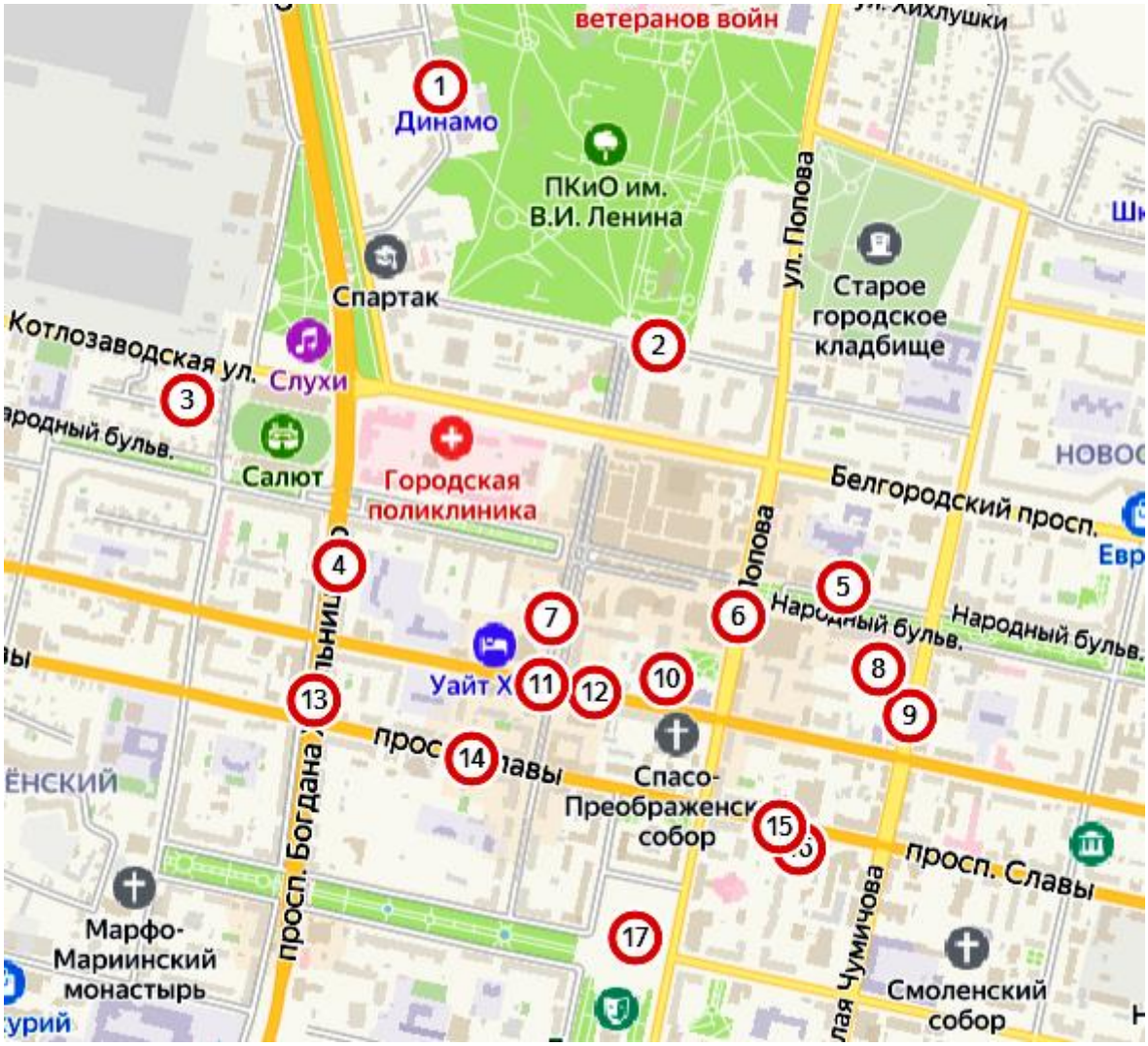


Fig. 1 - Incident location scheme.

In the videos taken by video recorders of local residents' cars during the shelling[9] [10] [11], a series of successive explosions can be heard occurring at short intervals. This picture is typical for the use of MLRS shells with a unitary warhead. The number of recorded shell impact sites allows us to assume that it was a small-caliber MLRS. Because MLRS with a caliber of more than 200 mm usually fire up to 6 missiles in one salvo. The version about the use of several installations is refuted by the rather dense location of the shell impact sites in the affected area.

Shell hit 1 The shell detonated in close proximity to the eastern wall of the Dynamo stadium building, 15 meters south of the main entrance, destroying the plastic roof and glazing of nearby windows, also causing fragmentation damage and destroying the windows of the Olympic Taekwondo school with a blast wave. This follows from footage taken by eyewitnesses on the day of the shelling[12].

[9] First incoming strikes in Belgorod (published on 30.12.2024) Explosions Belgorod Telegram Channel. URL: https://t.me/Vzrivi_Belgorod/125394 (accessed on 16.05.2024)

[10] Another video with the moment of an incoming strike in Bogdan Khmelnitsky Avenue (published on 30.12.2024) Tough stuff Belgorod Telegram Channel. URL: https://t.me/zhest_belgorod/36567 (accessed on 16.05.2024)

[11] The moment of today's incoming strike in Ostrovskogo St. (published on 30.12.2024) Tough stuff Belgorod Telegram Channel. URL: https://t.me/zhest_belgorod/36623 (accessed on 16.05.2024)

[12] Olympic Taekwondo School in Parkovaya (published on 30.12.2023) Belgorod #1 Telegram Channel. URL: https://t.me/belgorod01/47988 (accessed on 16.05.2024)

Fig. 2 - Shell hit in close proximity to the Dynamo stadium.[13]

Shell hit 2 Based on video and photographic materials posted by eyewitnesses in the public domain, the shell detonated in the parking area in Nikolaya Ostrovskogo Street[14], opposite the western end of the building at 19V Ostrovskogo St. from the side of the park named after V.I. Lenin. The detonation caused a fire in parked cars[15], also damaging them and the building at 19V Ostrovskogo St. with fragmentation and destroying the glazing of the building[16].

[13] Olympic Taekwondo School in Parkovaya (published on 30.12.2023) Belgorod #1 Telegram Channel. URL: https://t.me/belgorod01/47988 (accessed on 16.05.2024)

[14] Footage close to a fire in the city center (published on 30.12.2023) Tough stuff Belgorod Telegram Channel. URL: https://t.me/zhest_belgorod/36531 (accessed on 15.05.2024)

[15] A car burning in Ostrovskogo (published on 30.12.2023) Belgorod #1 Telegram Channel. URL: https://t.me/belgorod01/47933 (accessed on 16.05.2024)

[16] Footage close to a fire in the city center (published on 30.12.2023) Tough stuff Belgorod Telegram Channel. URL: https://t.me/zhest_belgorod/36531 (accessed on 16.05.2024)

Fig. 3 - The parking lot in Ostrovskogo St. after the shelling[17]

Shell hit 3 The projectile detonated on the asphalt surface, 30 cm west of the curb adjacent to the first entrance of the residential building at 2, Second Kotlozavodsky Lane. The projectile detonation caused fragmentation damage to the building and a car parked next to it, and a crater was formed with a cylindrical depression at the point of the projectile contact with the surface, and with fragmentation grooves located **south of the point of the projectile contact with the surface.**

[17] Parking near the Central Park from the side of Ostrovskogo St. (published on 30.12.2023) Belgorod #1 Telegram Channel. URL: https://t.me/belgorod01/47990 (accessed on 15.05.2024)

Fig. 4 - Shell hit at 2 Second Kotlozavodskiy Lane.[18]

Shell hit No. 4 It was caught by a video recorder camera installed on the wind shield of an eyewitness' car. As follows from the video material, the place of the MLRS shell detonation was located south of the intersection of Narodny Boulevard and Bohdana Khmelnytskogo Avenue[19].

Fig. 5 – The moment of the projectile detonation at the intersection of Narodny Boulevard and Bohdana Khmelnytskogo Avenue.

Shell hit 5 The projectile detonated on the sidewalk approximately three meters from the southern end of the building of Lyceum No. 9, located at 74,

[18] A shell fell near the building in 2nd Kotlozavodskiy Lane. (published on 30.12.2023) Explosions Belgorod Telegram Channel. URL: https://t.me/Vzrivi_Belgorod/125559 (accessed on 15.05.2024)

[19] The moment of incoming strike between Rodina and the Stadium. The very center of Belgorod. (published on 30.12.2023) Belgorod #1 Telegram Channel. URL: https://t.me/belgorod01/47996 (accessed on 16.05.2024)

Narodny Boulevard. The projectile detonation caused fragmentation damage to the lyceum building, and a crater was formed with a cylindrical depression at the point of the projectile contact with the surface, and with fragmentation grooves located **south of the point of the projectile contact with the surface.**

Fig. 6 – The shell crater found in the territory of lyceum No. 9[20].

Shell hit No. 6 It was caught by a video recorder camera installed on the wind shield of an eyewitness' car. As follows from the video material, the projectile detonated on the road surface in Popova Street in front of the northern corner of the *Belgorod* trading center building, causing fragmentation damage to cars and advertising stands, as well as the glazing of the trading center building.[21]

[20] Another footage with the consequences of shelling (published on 30.12.2023) Tough stuff Belgorod Telegram Channel. URL: https://t.me/zhest_belgorod/36541 (accessed on 16.05.2024)

[21] The moment the incoming rocket strike in the center of Belgorod. (published on 30.12.2023) Radar Belgorod Telegram Channel. URL: https://t.me/radarbel31/440 (accessed on 16.05.2024)

Fig. 7 - The moment of the projectile detonation in front of the northern corner of the Belgorod trading center building.

Shell hit 7 The shell hit the southern wing of the summer terrace of the *Potapych* pizzeria, located at 13A, 50th anniversary of the Belgorod Region Street. As a result of the detonation, the wooden frame of the southern wing of the summer terrace was completely destroyed.

Fig. 8 - Shell hit in the Potapych pizzeria.[22]

Shell hit 8 The shell detonated below a window group in the concrete wall of the first floor on the south side of the building at 63a Narodny Boulevard. As a result

[22] Belgorod downtown consequences. (published on 30.12.2023) Belgorod #1 Telegram Channel. URL: https://t.me/belgorod01/47997 (accessed on 16.05.2024)

of the detonation, a window was destroyed, a hole was formed in the outer concrete ceiling, and significant damage was caused to the interior decoration of the living room, the internal walls were damaged by fragmentation, and the partition wall was destroyed on the opposite side of the detonation site.

Fig. 9 - The shell hit at 63A Narodny Boulevard.[23]

Shell hit 9 The projectile detonation was recorded by an external surveillance camera installed on the southern end of the residential building at 39, Nikolaya Chumichova St. From the video material it becomes clear that the projectile detonated at the edge of the roadway in Nikolaya Chumichova Street near the northern corner of the building at the address 37, Nikolaya Chumichova St.[24]

[23] Belgorod. One of the shells hit the residential building at 63A Narodny Boulevard (published on 30.12.2023) VKontakte Social Network. URL: https://vk.com/wall-74016981_440328 (accessed on 16.05.2024)

[24] A couple more of tough videos with incoming strikes in Bogdanka and Chumichova. (published on 31.12.2023) Bletgorod Telegram Channel. URL: https://t.me/bletgorod/10521 (accessed on 16.05.2024)

Fig. 10 - The moment of the projectile detonation near the northern corner of the building at 37, Nikolaya Chumichova St.

Shell hit 10 The projectile detonated on the asphalt pavement surface at a distance of approximately 1 m from the fence of the building of the Ministry of Education of the Belgorod Region, located at 80, Preobrazhenskaya St., and the south-eastern corner of the building at 78A Preobrazhenskaya St. As a result of the projectile detonation a crater was formed with a cylindrical depression at the point of the projectile contact with the surface, and with fragmentation grooves located **south of the point of the projectile contact with the surface.**

Fig. 11 - A shell crater near the building of the Ministry of Education of the Belgorod Region.[25]

Shell hit 11 The shell detonated on the asphalt pavement surface at a pedestrian crossing in close proximity to the curb in front of the main entrance to the Mayak Trading Center, located at 11, 50th anniversary of the Belgorod Region Street. As a result of the detonation, the trading center building was damaged by fragmentation. A crater with a cylindrical depression was formed on the asphalt pavement surface at the point of the projectile contact with the surface, and with fragmentation grooves located **south of the point of the projectile contact with the surface.**

[25] Another footage with the consequences of shelling (published on 30.12.2023) Tough stuff Belgorod Telegram Channel. URL: https://t.me/zhest_belgorod/36541 (accessed on 16.05.2024)

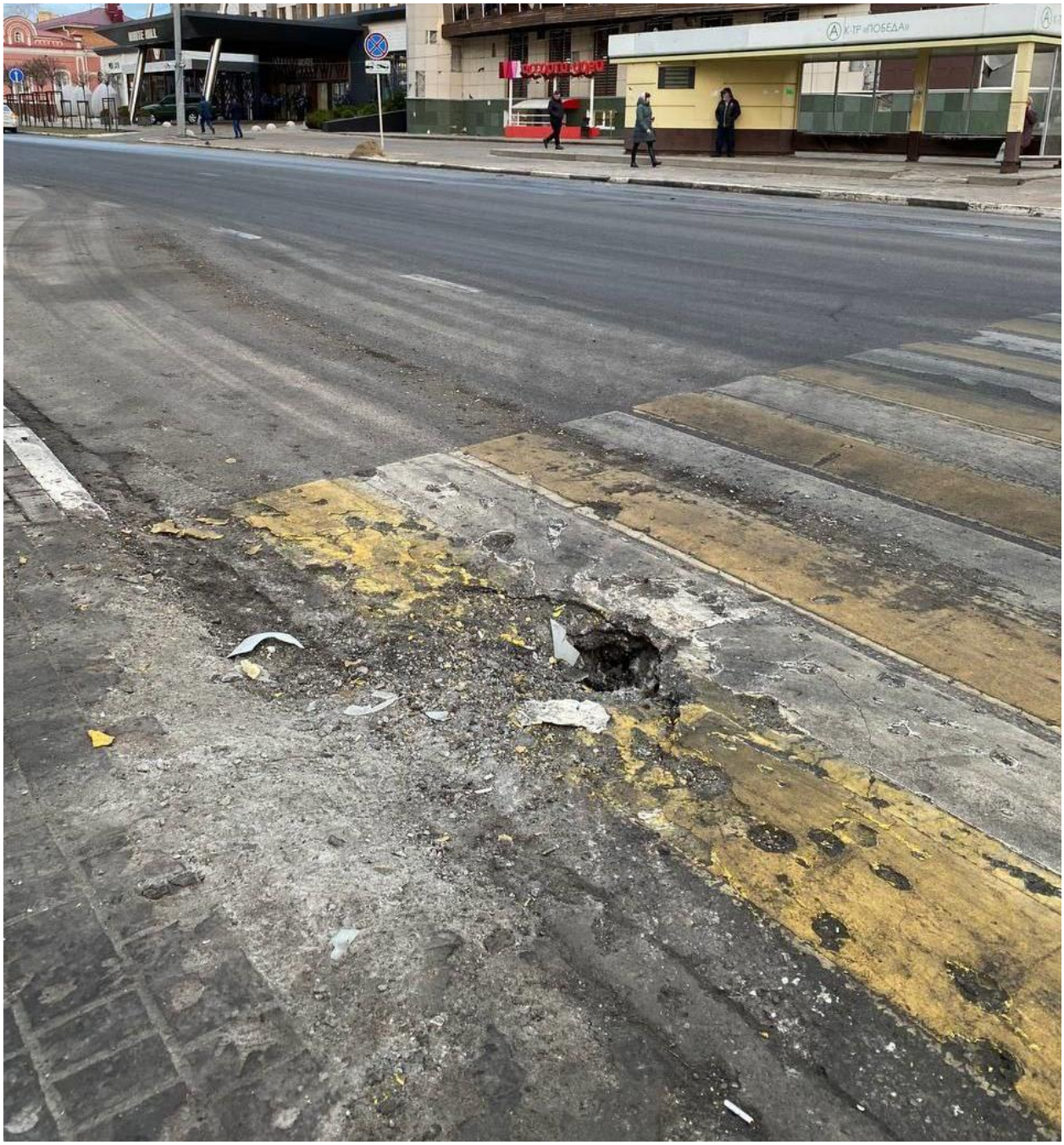


Fig. 12 - A shell crater next to the Mayak Trading Center.[26]

Shell hit 12 Based on photo and video materials taken by eyewitnesses, it was possible to determine that the shell hit occurred in Preobrazhenskaya Street, between the residential buildings at 82 and 63B Preobrazhenskaya St. As a result of the detonation, parked and passing cars caught fire, and nearby buildings were damaged by fragmentation and a blast wave.

[26] The death toll as a result of the UAF attack on Belgorod increased to 24 people - Gladkov (published on 30.12.2023) Tough stuff Belgorod Telegram Channel. URL: https://t.me/zhest_belgorod/36671 (accessed on 16.05.2024)

Fig. 13 - The shell hit near the Pobeda cinema.[27]

Shell hit 13 It was caught by eyewitnesses' cameras[28], it becomes clear from the video materials that the detonation occurred on the roadway surface closer to the lawn between the residential buildings at 81 and 38, Bohdana Khmelnitskogo Avenue closer to the intersection with Slavy Avenue, damaging surrounding buildings and causing car fires[29].

[27] Footage of the consequences of shelling by the UAF of a residential area in Belgorod (published on 30.12.2023) Tough stuff Belgorod Telegram Channel. URL: https://t.me/zhest_belgorod/36525 (accessed on 16.05.2024)

[28] Another video with the moment of an incoming strike in Bogdan Khmelnitsky Avenue (published on 30.12.2023) Tough stuff Belgorod Telegram Channel. URL: https://t.me/zhest_belgorod/36567 (accessed on 15.05.2024)

[29] "Horror! A car was hit behind us" (published on 30.12.2023) Tough stuff Belgorod Telegram Channel. URL: https://t.me/zhest_belgorod/36559 (accessed on 16.05.2024)

Fig. 14 - The place of the projectile detonation at the intersection of Bohdana Khmelnitskogo Avenue and Slavy Avenue,

Shell hit 14 It was recorded by eyewitnesses[30]. As becomes obvious from the video and photographic materials, the detonation occurred on the roof of the extension of the residential building at 47, Slavy Avenue next to the northwestern corner of the building. The explosion destroyed part of the extension canopy, an air conditioner, at the second-floor level and damaged the glazing of a nearby window.

[30] Consequences of an UAF strike in the center of Belgorod (published on 30.12.2023) Code Red Belgorod Region Telegram Channel. URL: https://t.me/chpbelgorod/11103 (accessed on 16.05.2024)

Fig. 15 - The shell hit near the "Delicatessen Store"[31]

[31] Center near the delicatessen store (published on 30.12.2023) Belgorod #1 Telegram Channel. URL: https://t.me/belgorod01/47931 (accessed on 16.05.2024)

Shell hit 15 The detonation of this projectile was recorded by an eyewitness video recorder camera mounted on the wind shield of the car[32]. The detonation occurred on the asphalt roadway surface in front of the entrance to the local area between residential buildings No. 43 and No. 41 in Slavy Avenue. As a result of the detonation, the building at 41, Slavy Avenue suffered damage to the façade and glazing, and a trolleybus[33], which at the time of detonation was located at a distance of several meters from the explosion epicenter, was also damaged.

A crater with a cylindrical depression was formed on the asphalt pavement surface at the point of the projectile contact with the surface, and with fragmentation grooves located **south of the point of the projectile contact with the surface.**

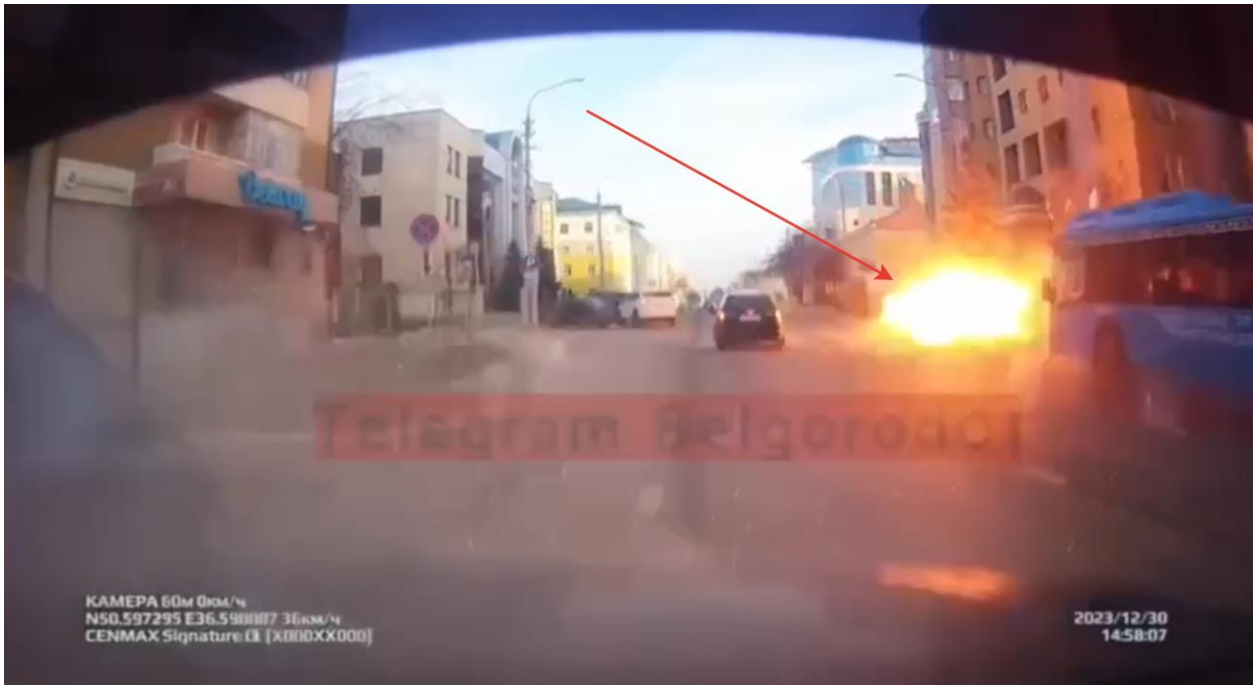


Fig. 16 – The moment of the projectile detonation near the Gazprom building in Slavy Avenue

[32] Yesterday's incoming strikes in Slavy Avenue and Bogdanka were caught on video. (published on 31.12.2023) Bletgorod Telegram Channel. URL: https://t.me/bletgorod/10519 (accessed on 16.05.2024)

[33] The Gazprom building in the center was riddled with fragmentation after the incoming strike (published on 30.12.2023) Belgorod #1 Telegram Channel. URL: https://t.me/belgorod01/47969 (accessed on 14.05.2024)

Fig. 17 - A crater near the Gazprom building in Slavy Avenue[34].

Shell hit 16 The detonation of this projectile was recorded on a video surveillance camera installed above entrance No. 6 of residential building No. 39 in Slavy Avenue, directed toward the entrance to the yard. An MLRS shell detonated in the soft soil of a lawn located on the western side of the junction of residential buildings 39 and 41 in Slavy Avenue. As a result of the detonation, fragmentation damage was caused to nearby buildings, the glazing of nearby windows was damaged, and a crater was formed with characteristic fragmentation grooves that plowed the soft soil, located on the **south side of the point of contact of the projectile with the surface.**

[34] Belgorod is coming to its senses, but the danger of shelling remains (published on 31.12.2023) smotrim.ru URL: https://smotrim.ru/article/3733978?ysclid=lw7uww2o8v809565520 (accessed on 10.05.2024)

Fig. 18 – A crater near residential building at 39, Slavy Avenue.[35]

Shell hit 17 The projectile detonated as a result of contact with the paving stones of Sobornaya Square. The detonation caused fire to temporary structures erected on the main square of the city of Belgorod for events dedicated to the celebration of the New Year.[36] As a result of the projectile detonation, a crater was formed with characteristic fragmentation grooves located **on the south side of the point of contact of the projectile with the surface**.

[35] Another footage with the consequences of shelling (published on 30.12.2023) Tough stuff Belgorod Telegram Channel. URL: https://t.me/zhest_belgorod/36541 (accessed on 16.05.2024)

[36] Shelling of a New Year tree in Belgorod (published on 30.12.2023) Dmitry Vasilets - official channel. URL: https://dzen.ru/b/ZZAQTyBkPkv6EfGp (accessed on 16.05.2024)

Fig. 19 - A crater in Sobornaya Square.

It is also worth noting that at least one shell explosion was recorded in the territory of the Belgorod Technological University[37]. In our opinion, these shell hits were caused by a change in the flight trajectory of some projectiles as a result of the air defense operation.

[37] Consequences of shelling the BSTU building (published on 30.12.2023) Tough stuff Belgorod Telegram Channel. URL: https://t.me/zhest_belgorod/36551 (accessed on 15.05.2024)

DETERMINATION OF THE WEAPON TYPE

Projectile debris

All the craters recorded in the affected area under consideration have a shape and size characteristic of ammunition that comes into contact with the surface at an angle close to 60 degrees, and differ from the craters that are typical for cluster warheads and mortar mines that come into contact with the surface at an angle close to 90 degrees. In addition, after the shelling, fragments of MLRS rockets of the same type were found.

Thus, in the video filmed by Belgorod Media reporters a cylindrical metal object can be seen in the immediate vicinity of **shell hit 6 that** has metallic color with remnants of the original green color[38]. The object is located on the roadway near the curbstone separating the roadway from the pedestrian area.

The dimensions of most curbs used in Belgorod are 1000 x 150 x 300 cm[39]. Note that curbs are installed on the principle of equality of the buried and above-ground parts; thus, the height of the curb relative to the roadway is at least (since the curb could settle) 15 cm, and the diameter of the cylindrical object is less than the height of the curb stone. Of all the MLRS in the arsenal of the countries participating in the conflict as of December 30, 2023, only the 122mm caliber is suitable for the obtained parameters.

[38] About the today's events I Shelling of Belgorod on December 30 (published on 30.12.2023) VKontakte Social Network. URL: https://vk.com/video/@belgorodmedia?z=video-113818503_456248388%2Fclub113818503%2Fpl_-113818503_-2 (accessed on 14.05.2024)

[39] CURB MANUFACTURED BY ZhBK-1 (date of publication is unknown). Website of Belgorod Precast Concrete Plant No. 1. URL: https://belbeton.ru/building-materials/catalog/338/146420/ (accessed on 11.05.2024)

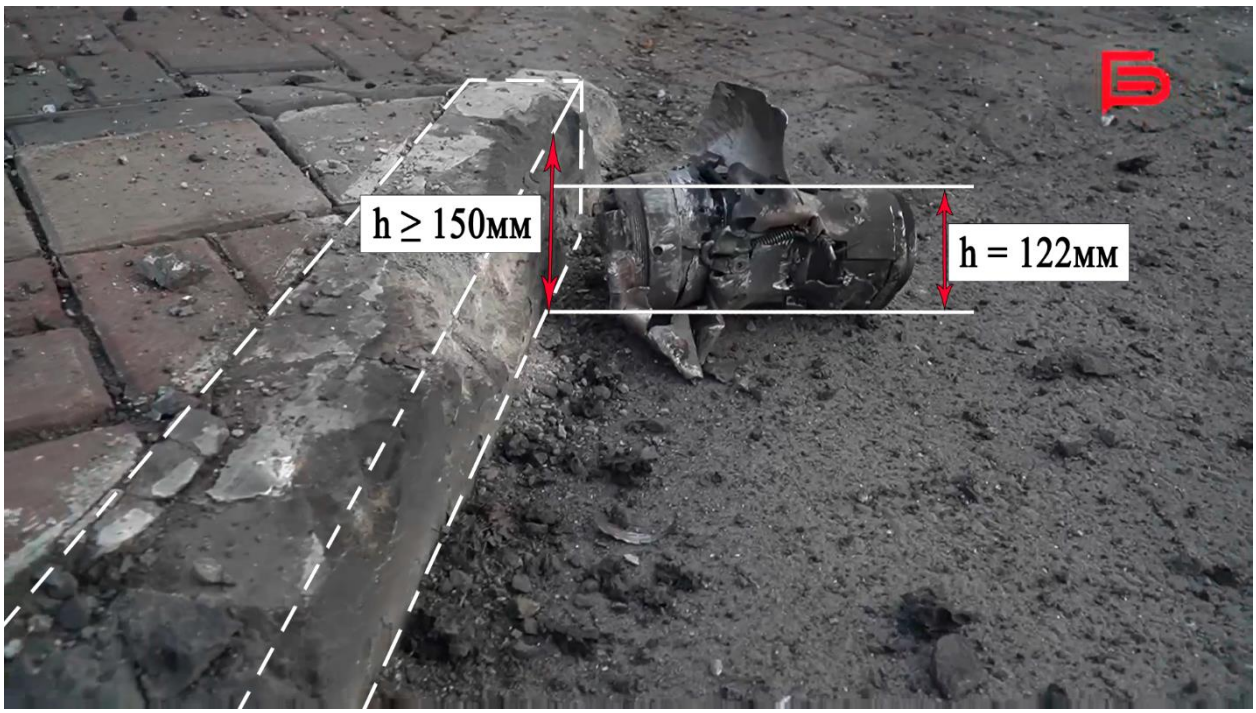


Fig. 20 - Determination of the projectile caliber.

In addition, in the center of Belgorod, another similar green cylindrical object was found with deformed threaded connections on both edges with a yellowish tint, and steel-colored inserts, which we identified as fastenings of the stabilizer blades, and the cylindrical object itself was identified as a fragment of the missile part of an MLRS projectile. Upon closer examination, a fragment of marking with the Latin letter "R" was discovered on the object[40].

Noteworthy, projectiles produced in the USSR, and in the Russian Federation, are marked with numbers and letters of the Cyrillic alphabet, and the letter "R" refers to the Latin alphabet, which indicates that this shell is not of Russian origin.

[40] Updated information about the consequences of the massive shelling of Belgorod (published on 31.12.2023) Explosions Belgorod Telegram Channel. URL: https://t.me/Vzrivi_Belgorod/125496 (accessed on 16.05.2024)

Fig. 21 - A fragment of the missile part of an MLRS projectile.

Based on the foregoing, it can be argued that **during the shelling of Belgorod under consideration, 122 mm MLRS rockets, produced in one of the countries of the Western bloc, were used.**

In addition, it is worth noting that in mid-February, after the shelling of the city of Belgorod, the remains of Serbian-made ER Grad 2000 rockets were found. This is evidenced by photographs (including those with markings) taken by eyewitnesses[41].

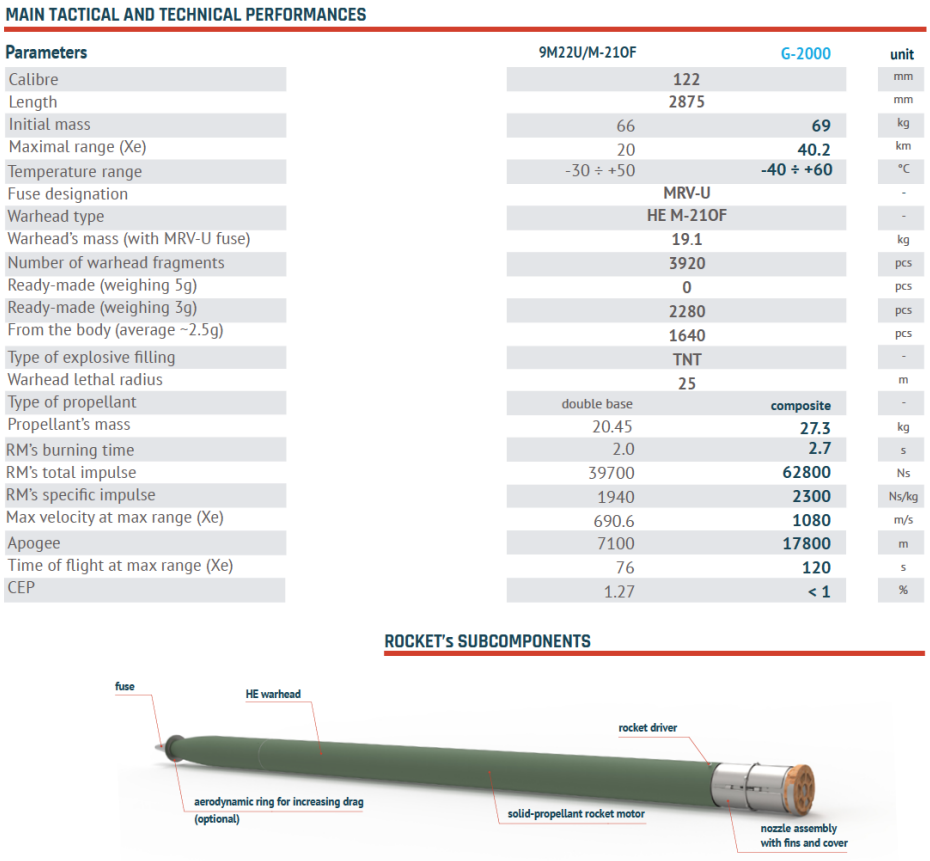
Long-range 122 mm rockets supplied to Ukraine

The flight range of a 122-mm rocket depends on the solid fuel production technology and the missile part of the projectile itself. The missile part of the

[41] Belgorod bombarded with Serbian-made missiles (published on 15.02.2023) Belgorod News Telegram Channel. URL: https://t.me/thenewsbelgorod/18178 (accessed on 16.05.2024)

projectile has a simple design and consists of solid fuel, a combustion chamber and a nozzle with a diffuser. Solid fuel is activated in the projectile body by an electrical impulse sent by the combat vehicle. In the case of changing the configuration of the combustion chamber, the type of fuel and its quantity, the energy of the projectile will increase, same as its flight range.[42].

Below we will consider long-range 122 mm rockets from the list of countries supplying weapons to Ukraine[43].



MAIN TACTICAL AND TECHNICAL PERFORMANCES

Parameters	9M22U/M-21OF	G-2000	unit
Calibre	122		mm
Length	2875		mm
Initial mass	66	69	kg
Maximal range (Xe)	20	40.2	km
Temperature range	-30 ÷ +50	-40 ÷ +60	°C
Fuse designation	MRV-U		-
Warhead type	HE M-21OF		-
Warhead's mass (with MRV-U fuse)	19.1		kg
Number of warhead fragments	3920		pcs
Ready-made (weighing 5g)	0		pcs
Ready-made (weighing 3g)	2280		pcs
From the body (average ~2.5g)	1640		pcs
Type of explosive filling	TNT		-
Warhead lethal radius	25		m
Type of propellant	double base	composite	-
Propellant's mass	20.45	27.3	kg
RM's burning time	2.0	2.7	s
RM's total impulse	39700	62800	Ns
RM's specific impulse	1940	2300	Ns/kg
Max velocity at max range (Xe)	690.6	1080	m/s
Apogee	7100	17800	m
Time of flight at max range (Xe)	76	120	s
CEP	1.27	< 1	%

ROCKET's SUBCOMPONENTS

Fig. 22 - Information about the ER Grad 2000 rocket in the manufacturer's brochure.

ER Grad 2000[44]. The 122-mm long-range rocket ER Grad 2000 (G2000) is produced by the Serbian company EDePro. It can cover distances from 20 to 40.5

[42] Long-range 122-mm rockets for multiple launch rocket systems by country of origin (published on 16.02.2024) "Armament · Army · Military Analytics" Website "URL: https://amalantra.ru/dalnoboynyye-122-mm-reaktivnyye-snaryady/ (accessed on 10.05.2024)

[43] List of military aid to Ukraine during the Russo-Ukrainian War (date of publication is unknownhttps://en.wikipedia.org/wiki/List_of_military_aid_to_Ukraine_during_the_Russo-Ukrainian_War (accessed on 14.05.2024)

[44] MLRS G-2000 122MM (date of publication is unknown) EDePro Website. URL: https://www.edepro.com/products-and-services/rockets/artillery/mlrs-grad-g-2000 (accessed on 15.05.2024)

kilometers. This rocket-propelled high-explosive fragmentation ammunition weighs up to 69 kilograms, and its length is 2.875 meters. The warhead mass is 19.1 kilograms. The amount of solid fuel in the projectile has been increased up to 27.3 kilograms, which is more than in standard Grad projectiles, where the fuel mass is 20.45 kilograms. According to the manufacturer's information, the specific impulse of the projectile was increased to 2,300 Ns/kg. The maximum flight speed varies from 690 to 1,100 meters per second. The vertical flight path ranges from 7,100 to 17,800 meters. The flight time of a projectile over a distance of 40 kilometers makes 126 seconds, that is, a little more than two minutes.

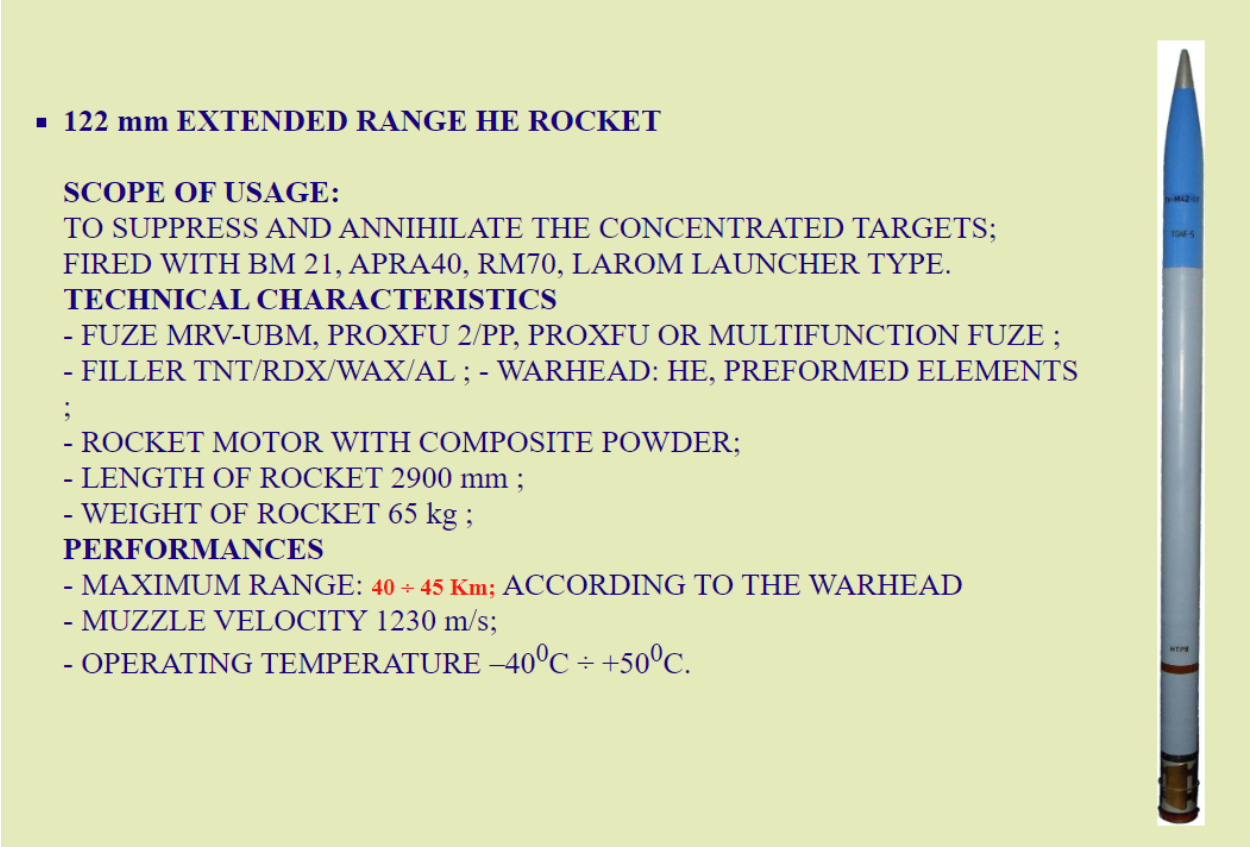


Fig. 23 - Information about the ER 122-mm HE extended range projectile on the manufacturer's website.

ER 122 mm HE (Extended Range Rocket)[45]. This rocket is produced by the **Romanian** company S.TOHAN SA Zarnesti. According to the manufacturer's technical specifications, this projectile is compatible with MLRS systems such as

[45] Military Products (date of publication is unknown) Tohan Website. URL: http://www.tohan.ro/122%20mm%20ROCKETS%20FAMILY.html (accessed on 14.05.2024)

BM-21 Grad, APRA40 (Romania), RM-70 Vampire (Czech Republic) and LAROM (Romania-Israel). The effective target engagement range is up to 42 km. The total mass of this projectile is 64 kg. Of these, 18.4 kg is the mass of the warhead, and the projectile is 2.9 meters long. The maximum initial speed of the projectile is 1,430 m/s, and the mass of solid fuel in the rocket is 24.8 kg.

122 MM HE ROCKETS "GRAD" FOR 122 MM MLRS

The 122 mm HE rocket and 122 mm HE extended-range rocket were developed for the 122 mm MLRS (multiple rocket launcher systems) BM-21 GRAD and RM – 71, but can be used with any equivalent rocket launcher of similar design and characteristics. HE missiles are intended for use against the enemy in open and field shelters, to create passageways in minefields, and to destroy armor.

MSM GROUP offers its customers a standard 122 mm HE missile with a range of 20 km and a 122 mm HE missile with an extended range of 40 km. All our missiles are supplied with the MRV-U fuse, which is a standard "GRAD" compatible fuse. The igniter is a mechanical, point detonation igniter with optional SQ or delayed action. The barrel has an internal section with prefabricated iron fragments for higher fragmentation efficiency. Our 122 mm rockets have been delivered to over 8 countries worldwide. We are one of the few companies producing such ammunition in NATO and EU territory.

Fig. 24 - Information about the 122-mm HE extended range projectile on the manufacturer's website.

122-mm HE extended range[46]. This 122-mm extended-range rocket is produced by the **Slovak** defense-industrial company MSM Group. The company manufactures this ammunition for the Slovak-German version of the RM-70 modified MLRS, which is produced in Slovakia under the Czech license RM-70. This missile has a destruction range of up to 40 kilometers, a total mass of 69 kilograms, of which 19.1 kilograms is attributed to the warhead. The initial speed of the ammunition is 1,100 meters per second.

[46] 122 MM HE ROCKETS "GRAD" FOR 122 MM MLRS (date of publication is unknown) MSM Groupe Website. URL: https://www.msm.sk/en/produkt/122-mm-he-rockets-grad-for-122-mm-mlrs/ (accessed on 16.05.2024)

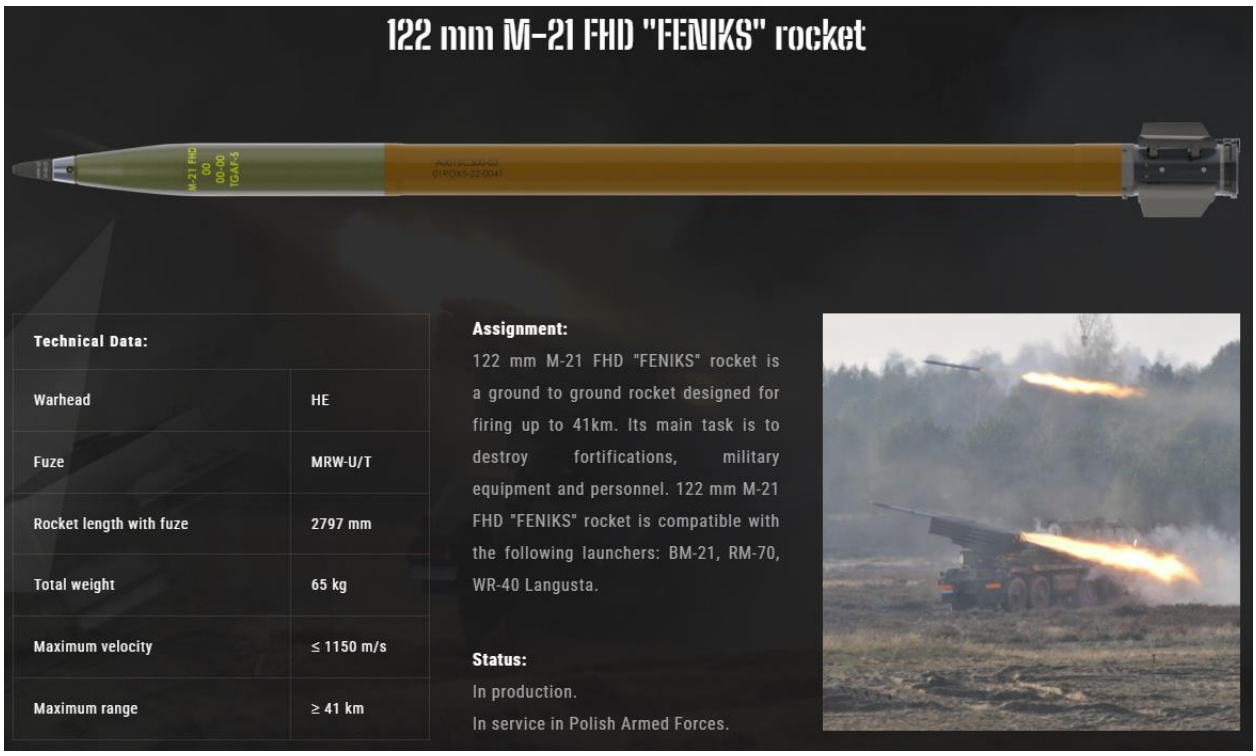


Fig. 25 - Information about the M-21 FHD "Feniks" projectile on the manufacturer's website.

M-21 FHD "Feniks"[47]. This rocket was developed by the **Polish** company Mesko SA for use in the WR-40 Langusta multiple launch rocket systems and the Czech RM-70 systems, including the Vampire modification. The projectile belongs to the Feniks-Z line of ammunition, the name of which comes from the testing region at the Zagan proving ground, where they were carried out in August 2001. The M-21 Feniks FHE projectile has a high-explosive fragmentation warhead weighing 18.4 kilograms and contains up to 6,000 fragments. It is 1.983 meters long. The line also includes the M-21FK Feniks projectile weighing 23.5 kilograms, equipped with 42 cumulative fragmentation combat elements. The destruction range of this projectile is 32 kilometers.

[47] 122 mm M-21 FHD "FENIKS" rocket (date of publication is unknown) Mesco Website. URL: https://www.mesko.com.pl/en/product/122-mm-m-21-fhd-feniks-rocket (accessed on 14.05.2024)

The 122 mm TRG-122 Guided Rocket provides accurate and effective fire power on high priority targets within the ranges of 13-30 km.

Fig. 26 - Information about the TRG-122 projectile on the manufacturer's website.

TRG-122[48]. This 122mm rocket is produced by the **Turkish** company Roketsan.It has a destruction range of up to 40 kilometers. The projectile weighs 72 kilograms, of which 18.4 kilograms are attributed to the combat high-explosive fragmentation part. The TRG-122 projectile is highly precise and equipped with a GPS system. In addition, the Turks produce the TRB-122 rocket for their T-122 Sakarya multiple launch rocket system. It also has an increased range of 40 kilometers, is 2930 meters long and weighs 65.9 kilograms.

[48] TRG-122 (publication date is unknown) Roketsan Website. URL: https://www.roketsan.com.tr/en/products/trg-122-guided-rocket (accessed on 16.05.2024)

SHELLING DIRECTION

At all shell hits where craters were formed on the horizontal surface (shell hits 3, 5, 10, 11, 15, 16 and 17), fragmentation grooves were located south of the point of contact of the projectile with the surface. Considering that these craters can be defined as craters of the second type,[49] allows us to assert that the shelling was carried out from the direction indicated by the location of the fragmentation grooves relative to the point of contact of the projectile with the surface.

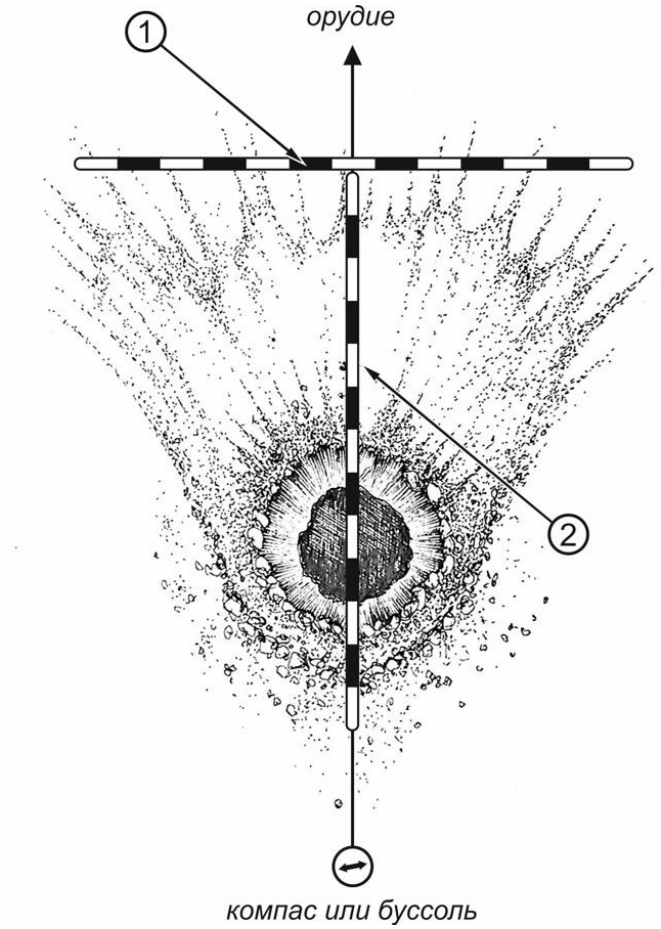


Fig. 27 – Determination of the shelling direction by the method of fragmentation grooves

More precisely, the shelling direction can be determined by examining shell hit 5. In the photo taken by an eyewitness, the crater from the explosion on the

[49] ANALYSIS OF CRATERS FROM HIGH EXPLOSIVE SHELLS (published on 2015) VKontakte Social Network. URL: https://vk.com/wall-95389776_278 (accessed on 15.05.2024)

sidewalk and the trace from the main flow of fragmentation scatter on the wall of the building are clearly visible.

Fig. 28 - The crater and the trace from the main flow of fragmentation scatter in the case of shell hit 5.

By connecting the point of the projectile contact with the surface and the lower point of the trace, left by the main flow of fragmentation scatter, we obtain a line perpendicular to the vector of the shelling direction.

By applying this data on a satellite image and carrying out the above manipulations, we obtained an azimuth of 195 degrees.

It is also worth noting that the shape of the craters and the location of the trace from the main flow of fragments at a fairly low level relative to the crater indicates that the projectile came into contact with the surface at an angle close to 60 degrees, which in turn indicates that the **shelling was carried out at a distance close to the maximum.**

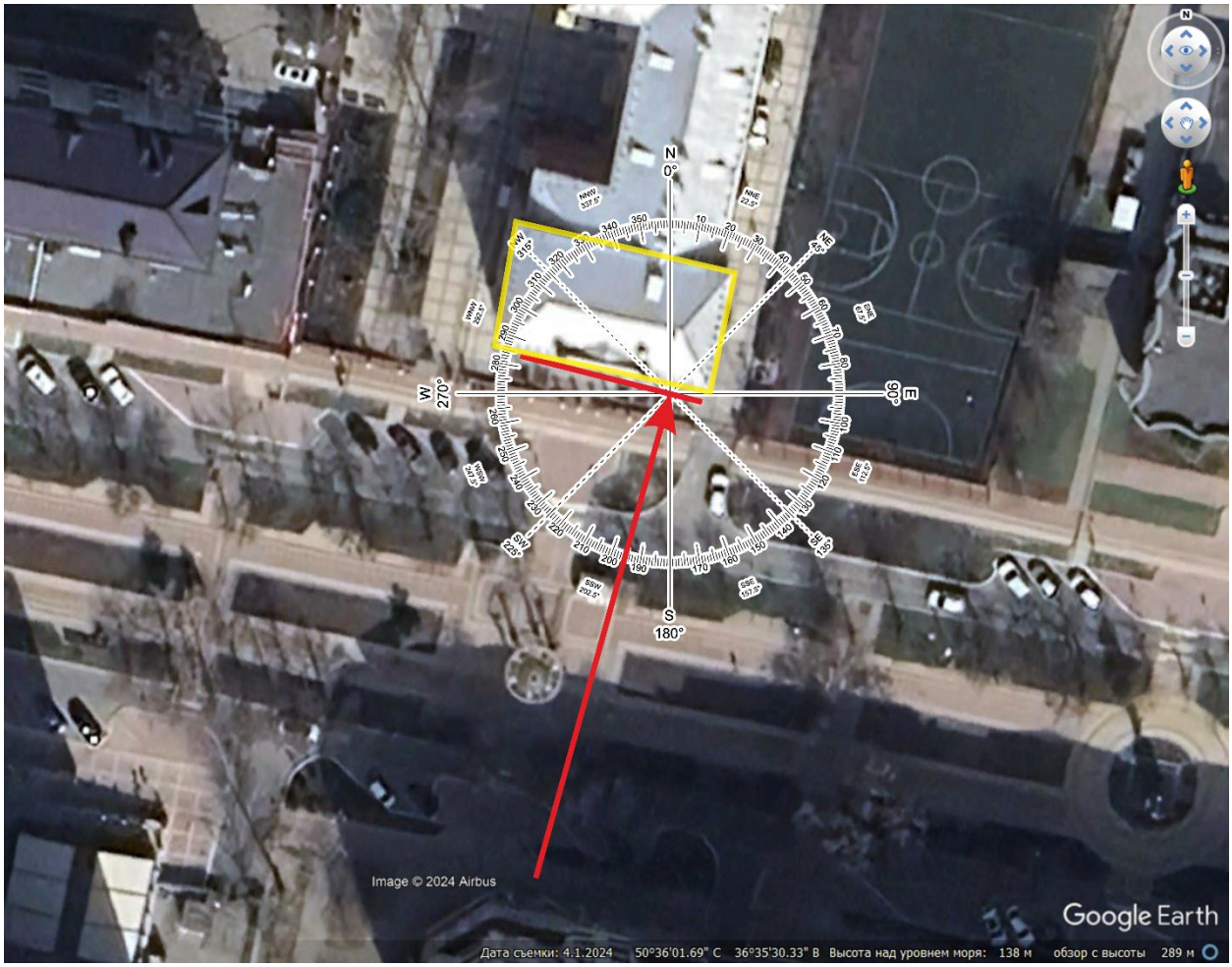


Fig. 29 – Fire direction determination in the case of shell hit 5.

Thus, it can be argued that **the shelling under consideration was conducted from the south-southwest to the north-northeast along an azimuth of 195 degree**s. Let us take the measurement error to be plus or minus 15 degrees.

Having plotted on the map the lines drawn on the basis of the data we described, as well as the border between Russia and Ukraine (the latter was also the line of combat contact that day), we received the sector from which this shelling was carried out. This sector covers the area of the settlements of **Glubokoe and Lukyantsy**.

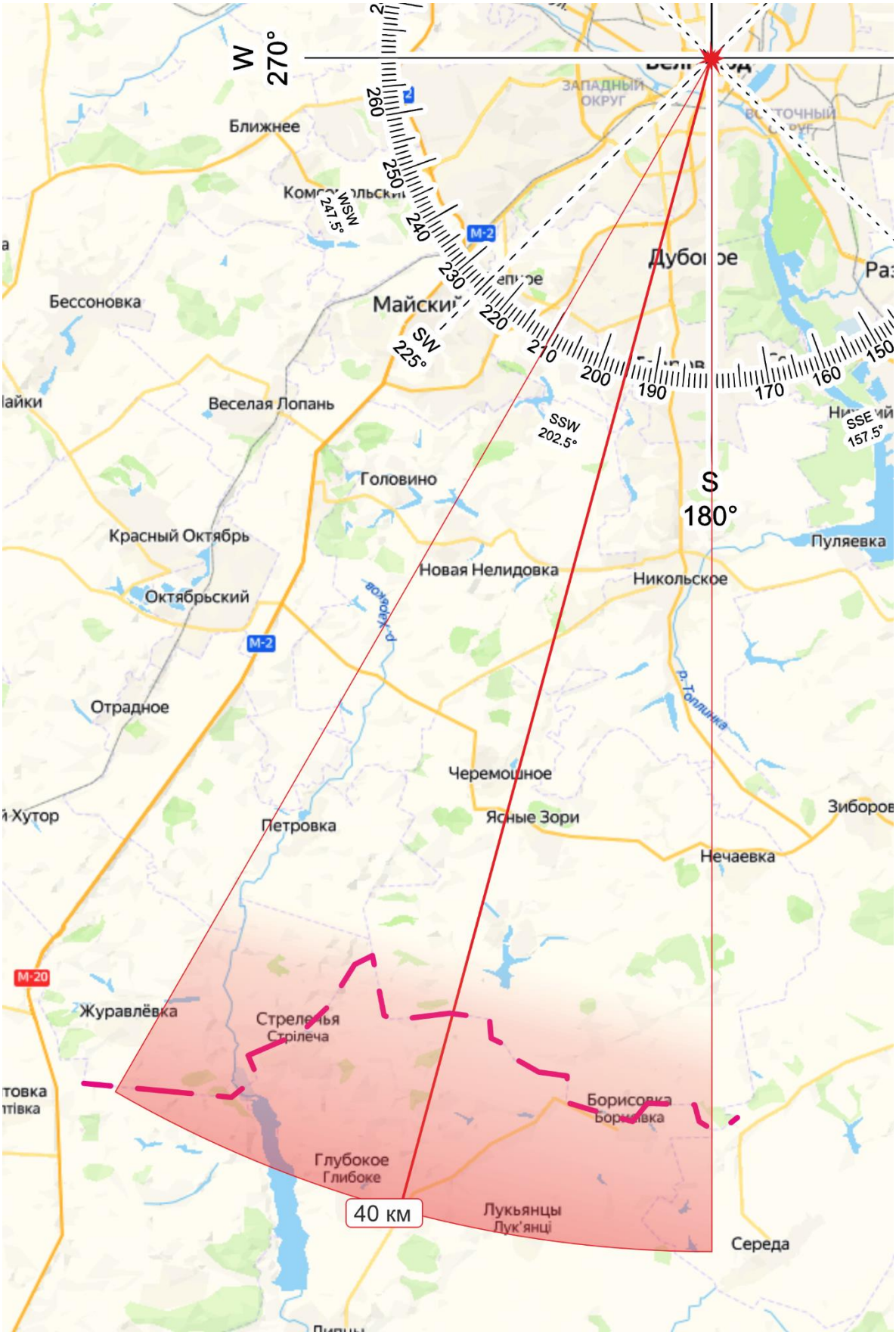


Fig. 30 - The sector from which a 12-mm MLRS salvo was fired into the city of Belgorod on December 30, 2023.

PRESENCE OF THE UKRAINIAN ARMED FORMATIONS

The main role in the attacks on Belgorod was played by the Russian Volunteer Corps (listed as a terrorist organization in the territory of the Russian Federation[50]), subordinate to the main intelligence department of the Ministry of Defense of Ukraine[51]. According to data from open sources, since November 2022, the Russian Volunteer Corps has left the territory of the Zaporozhye region[52] [53], moving to the northeast of Ukraine to carry out terrorist activities in the border area.

In March 2023, the RVC arranged a raid in the Bryansk region[54] and in April 2023 in the Kursk region[55]. On May 22, 2023, their activities in the Belgorod region were mentioned for the first time[56], and in June 2024, the RVC attempted to invade the territory of the Russian Federation, capturing the village of Novaya Tavolzhanka in the Belgorod region[57]. The presence of this unit as of December 2023 in the designated sector is confirmed by the liquidation of their curators as a result of shelling of Kharkov[58], and the demonstration of their subversive activities on the air of the Ukrainian TV channel "Channel 24" in January 2024[59].

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[50] The FSB added the Russian Volunteer Corps to the list of terrorist organizations (published on 30.12.2023) RG.RU Mass Media. URL: https://rg.ru/2023/12/30/fsb-vnesla-russkij-dobrovolcheskij-korpus-v-spisok-terroristicheskih-organizacij.html (accessed on 16.05.2024)

[51] "Several waves of volunteers have already arrived in Ukraine" (published on 22.04.2023) Novaya Gazeta Mass Media. https://novayagazeta.eu/articles/2023/04/22/nas-v-ukrainu-priekhalo-uzhe-neskolko-voln-dobrovoltsev (accessed on 16.05.2024)

[52] "Russian Volunteer Corps" as part of the UAF: why the Russians are fighting against Putin (published on 20.12.2022) "Crimea. Realities" Mass Media. URL: https://ru.krymr.com/amp/russkiy-dobrovolcheskiy-korpus-vsu-voyna-intervyi/32185108.html (accessed on 16.05.2024)

[53] Results of the year (published on 02.01.2023) Telegraph website. URL: https://telegra.ph/Itogi-goda-01-02-2 (accessed on 16.05.2024)

[54] Russian far-right fighter claims border stunt exposes Putin's weakness. Financial Times. https://www.ft.com/content/c4ffe9b8-a3f5-4f33-a420-effe32754bbf (accessed on 16.05.2024)

[55] The authorities hid the death of a border guard during a "raid" of the Ukrainian hit squad in the Bryansk region (published on 12.04.2023) Komsomolskaya Pravda. URL: https://novayagazeta.eu/articles/2023/04/12/vlasti-skryvaiut-gibel-pogranichnika-vo-vremia-reida-ukrainskoi-drg-v-brianskoi-oblasti-news (accessed on 16.05.2024)

[56] "Subversive reconnaissance unit" entered the Belgorod region. What is known (published on 22.05.2023) BBC News. URL: https://www.bbc.com/russian/news-65673136 (accessed on 16.05.2024)

[57] Russia thwarts more Belgorod attacks, blames Ukraine. ALJAZEELA URL: https://www.aljazeera.com/news/2023/6/2/russia-says-thwarts-more-belgorod-attacks-blames-ukraine (accessed on 16.05.2024)

[58] A resistance fighter reported on the liquidation of RVC curators in Kharkov (published on 18.01.2024) RIA News Mass Media. https://ria.ru/20240118/kharkov-1922063782.html (accessed on 16.05.2024)

[59] Unique footage! RVC showed a RAID in the Bryansk region / Watch UNTIL THE END (published on 20.01.2024) YouTube channel of Ukrainian TV channel "Channel 24" URL: https://www.youtube.com/watch?v=ca8CTNB7P3M (accessed on 16.05.2024)

Noteworthy, on June 1, 2023, the official Telegram channel of the Russian Volunteer Corps confirmed the presence of 122mm MLRS in their arsenal[60].

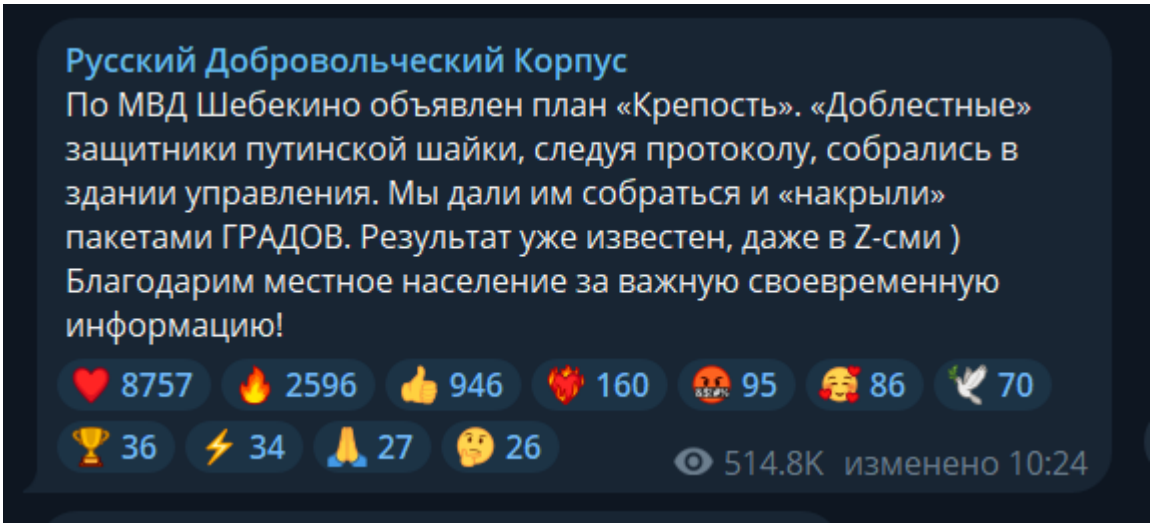

Fig. 31 – Excerpt from a message on the RVC Telegram channel

Thus, it can be argued that in the vicinity of the settlements of Glubokoe and Lukyantsy, Kharkov region, there were combatants from the Russian Volunteer Corps, which is armed with 122mm MLRS.

As for the persons who could give the order to shell a crowded place in Belgorod using 122-mm projectiles, the RVC commander, Denis Evgenievich Kapustin with the call sign “White Rex” is primarily responsible for this.[61]

[60] The “Fortress” plan announced for the Shebekino MIA (published on 01.06.2023) Russian Volunteer Corps Telegram channel. URL: https://t.me/russvolcorps/568 (accessed on 16.05.2024)

[61] The founder of RVC is wanted in the Russian Federation (published on 27.03.2023) “DW” URL: https://www.dw.com/ru/osnovatel-russkogo-dobrovolceskogo-korpusa-obavlen-v-rozysk-v-rf/a-65131489 (accessed on 16.05.2024)

Fig. 32 - RVC leader Denis Kapustin.[62]

However, open sources contain very little information about Ukrainian units located in the period under consideration nearby the settlements of Glubokoe and Lukyantsy, Kharkov Region. In our understanding, we will be able to obtain more detailed information in the future.

At the same time, the fact remains undoubted that the highest military-political leadership of Ukraine is responsible for the illegal actions of the UAF, Namely, they are President and Supreme Commander-in-Chief **Vladimir Zelensky**, Commander-in-Chief of the Armed Forces of Ukraine **Alexander Syrsky** and head of the Main Intelligence Directorate **Andrey Budanov**.

[62]The identity of one of the terrorists who attacked the Bryansk region established (published on 02.03.2023) Reporter Mass Media. URL: https://topcor.ru/32686-ustanovlena-lichnost-odnogo-iz-terroristov-napavshih-na-brjanskuju-oblast.html (accessed on 16.05.2024)

CONCLUSIONS

As follows from the above, on December 30, 2023, at 15:00 a.m. (Moscow time), Belgorod downtown came under artillery fire using 122-mm MLRS. During the attack, extended-range rockets produced by one of the Western bloc countries were used. The shells flew in a direction from south-southwest to north-northeast along the azimuth of 195 degrees. Let us take the measurement error to be plus or minus 15 degrees.

All shell hits fell on densely populated residential areas of the city and led to damage to civilian objects, death and injury to civilians. Thus, the principles of selectivity and proportionality were violated.

The UAF units were located in the shelling sector. Extended-range 122-mm missiles had been supplied in large quantities by Western bloc countries to Ukraine and are in service with UMF units.

The commander of the RVC, **Denis Kapustin**, is primarily responsible for the illegal actions of his subordinates. Moreover, the highest military-political leadership of Ukraine is responsible for crimes committed during this armed conflict. Namely, they are President and Supreme Commander-in-Chief **Vladimir Zelensky**, Commander-in-Chief of the Armed Forces of Ukraine **Alexander Syrsky** and head of the Main Intelligence Directorate **Andrey Budanov**.

LEGAL QUALIFICATIONS

Indiscriminate shelling of a densely populated residential area inthe town of Makeyevka, in which civilians were killed and injured, is a crime for which responsibility is provided by the norms of national legislation of Ukraine and by the norms of international law.

The acts described above first of all violate the principle of **proportionality,** which declares as prohibited "*attacks which may be expected to cause incidental loss of civilian life, injury to civilians, damage to civilian objects, or a combination thereof, which would be excessive in relation to the concrete and direct military advantage anticipated*".

This principle is enshrined in **Article 51(5)(b)** and is repeated in **Article 57** of **Additional Protocol I** to the 1949 Geneva Conventions. It is also recognized as **rule 14 of customary international humanitarian law** and applies to both international and internal armed conflicts.

Moreover, the acts in question can be qualified as **indiscriminate attacks**.

Article 51(4) of Additional Protocol I to the 1949 Geneva Conventions expressly prohibits indiscriminate attacks and reckons the following among them: "*(a) those which are not directed at a specific military objective; (b) those which employ a method or means of combat which cannot be directed at a specific military objective; or (c) those which employ a method or means of combat the effects of which cannot be limited as required by this Protocol*".

In compliance with **Rule 71 of Customary International Humanitarian Law**: "*States must never make civilians the object of attack and must consequently never use weapons that are incapable of distinguishing between civilian and military targets*"

In compliance with **Art. 3 common to all Geneva Conventions of August 12, 1949,** extending its effect to all types of armed conflicts, "*persons taking no active part in the hostilities, including members of armed forces who have laid down their arms and those placed 'hors de combat' by sickness, wounds, detention, or any other cause, shall in all circumstances be treated humanely, without any adverse*

distinction founded on race, colour, religion or faith, sex, birth or wealth, or any other similar criteria".

To this end, violence to life and person, in particular murder of all kinds and mutilation, are prohibited inter alia with respect to the above-mentioned persons.

In addition to the above, it should be noted that **the practice of the International Criminal Tribunal for the former Yugoslavia** allows us to assert that deliberate terror of civilians includes deliberate and indiscriminate firing at civilian targets.

This makes it possible to state about the violation of **Article 51(2) of Additional Protocol I to the 1949 Geneva Conventions**, which prohibits *"acts or threats of violence the primary purpose of which is to spread terror among the civilian population"*.

In compliance with **Art. 438 of the Criminal Code of Ukraine**, for "... *use of methods of the warfare prohibited by international instruments, or any other violations of rules of the warfare recognized by international instruments consented to be binding by the Verkhovna Rada (Parliament) of Ukraine, and also giving an order to commit any such actions*", shall be punishable by imprisonment for a term of eight to twelve years, and if the same acts accompanied with an intended murder, shall be punishable by imprisonment for **a term of ten to fifteen years, or life imprisonment**.

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