



Evolution of the MSBS Grot Assault Rifle from Version A0 to Version A2

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Abstract. On 15 December 2017, Fabryka Broni “Łucznik”-Radom Sp. z o.o. (FB Radom), a subsidiary of Polska Grupa Zbrojeniowa S.A., delivered the first batch of 1,000 MSBS Grot C 16 FB M1 calibre 5.56 mm standard (basic) assault rifles (version A0) to the Polish Territorial Defence Force and thus initiated the process of deployment of the assault rifle in the Polish Armed Forces. MSBS Grot was developed by Polish design and process engineers at FB Radom and the Military University of Technology (MUT, Warsaw, Poland) who by mediation of the proper Armament Acquisition and Development Department collected the improvement suggestions and operational feedback from 2.5 years of testing by operators from the armed forces.

The suggestions and feedback were thoroughly analysed and discussed during periodic meetings attended by the representatives of the Territorial Defence Force (TDF) Command, the Special Forces Component Command, the 3rd Regional Military Representation (RMR), MUT, and FB Radom. Based on the conclusions from the testing period and the results of theoretical and instrumental testing of the solutions proposed for implementation, the MSBS Grot assault rifles show systematic improvements up to the current version, A2. This paper presents the design of the MSBS Grot Version A0 assault rifle and the construction and processing modifications for version A1 and version A2. During the optimisation effort backed by theoretical and instrumental testing, there was special focus on the assurance of high operating safety and reliability, plus the required ergonomics of the assault rifle under various operating conditions. The paper also presents the avenues for further potential improvements of MSBS Grot.

Keywords: mechanical engineering, firearms, weapons, assault rifle

1. INTRODUCTION

During the 25th International Defence Industry Expo in Kielce on 5 September 2017, a contract for the purchase and delivery of approximately 53,000 units of the MSBS Grot C 16 FB M1 standard (basic) assault rifles in the classic (stocked) design configuration (version A0). On 30 November 2017, the first batch of the MSBS Grot C 16 FB M1 assault rifles (version A0) was symbolically handed over by veterans of the Polish Home Army, Lt. Jerzy “Czarny” Majkowski (call sign “Black”, ret.) and Mjr Zbigniew “Kowboj / Dym” Matysiak (call sign “Cowboy” / “Smoke”, ret.) to the operators of the Polish Territorial Defence Force (TDF) under the statue of the legendary Commander-in-Chief of the Union of Armed Struggle and of the Home Army, General Major Stefan “Grot” Rowecki. Less than two weeks later, on 15 December 2017, FB Radom completed the delivery of the 1000 MSBS Grot assault rifles to TDF. By the middle of 2020, the Polish Army was armed with over 35,000 MSBS Grot assault rifles [3].

Already at the preparation stage of the MSBS Grot purchase and delivery contract it was decided that the operation of the assault rifles would be closely monitored by the TDF Command (as a Military Ordnance Utility) and all feedback from the weapon’s users would be presented and discussed during annual meetings attended by the representatives of the Military Ordnance Utility, the Central Office of Logistics (i.e. the Cabinet of Chiefs of the Armament and Electronic Equipment Services at the Armed Forces Support Inspectorate), the Special Forces Component Command, the 3rd Regional Military Representation (RMR), MUT, and FB Radom. The purpose of the meetings was to formulate conclusions concerning potential future avenues for improvement of the MSBS Grot assault rifles from version A0 to version A1 and, ultimately, version A2.

2. MSBS GROT VERSION A0 ASSAULT RIFLE

The MSBS GROT C16 FB M1 standard assault rifle, version A0, as characterised in [1-3] and illustrated in Fig. 1 and 2, comprises eight primary components: the buttstock assembly, the upper receiver assembly (with detachable mechanical sights), the barrel assembly, the recoil mechanism assembly, the lower receiver assembly, the bolt and bolt carrier assembly, the cartridge magazine, and the handguard assembly. The essential tactical and technical specifications of the Grot are listed in Table 1.

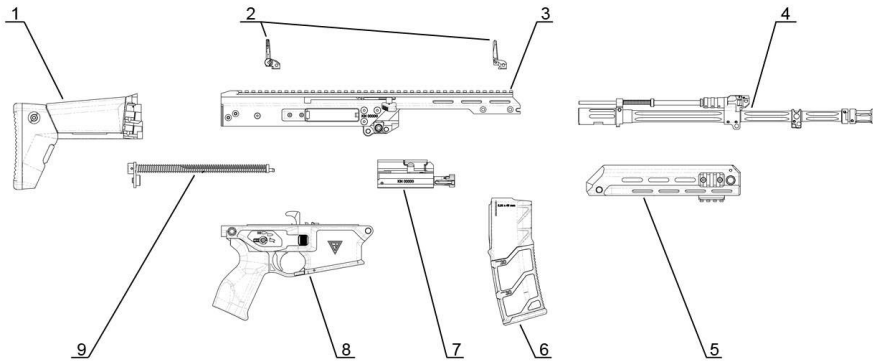


Fig. 1. Primary components of the MSBS GROT Version A0 standard (basic) assault rifle in the classic (stocked) design configuration:

1 – buttstock; 2 – mechanical sights; 3 – upper receiver; 4 – barrel; 5 – handguard; 6 – magazine, 7 – bolt and bolt carrier (slide); 8 – lower receiver; 9 – recoil mechanism

Table 1. The essential tactical and technical specifications of the MSBS GROT Version A0 standard (basic) assault rifle in the classic (stocked) design configuration

#	Specification	Units	Parameter
1.	Cartridge	mm	5.56 × 45
2.	Overall weight w/mechanical sights	kg	approx. 3.75
3.	Overall length	mm	approx. 900
4.	Barrel length / rifle pitch	mm	406 / 178
5.	Theoretical rate of fire	shots/min	700-900
6.	Muzzle velocity	m/s	approx. 870
7.	Muzzle energy	J	approx. 1600
8.	Magazine capacity	rounds	30



Fig. 2. MSBS Grot calibre 5.56 mm standard (basic) assault rifle, version A0: right-hand view (top image); left-hand view (bottom image): 1 – flash suppressor; 2 – interchangeable barrel; 3 – knife/bayonet mount; 4 – two-position gas regulator; 5 – charging handle, two-sided; 6 – upper receiver w/full-length Picatinny rail (STANAG 4694); 7 – two-sided ejection port with spent case ejection side switchover capability; 8 – telescoping buttstock (5-position), folding away to the right-hand side and complete with an adjustable cheek pad; 9 – two-sided safety/fire mode selector lever; 10 – interchangeable AR15/M16 style pistol grip (imported); 11 – two-sided magazine catch; 12 – two-sided bolt catch; 13 – AR15/M16 style magazine; 14 – handguard with mounting rails (MOE) to accommodate, for example, a front grip, a flashlight, or a 40 mm under barrel grenade launcher

3. MSBS GROT VERSION A1 ASSAULT RIFLE

During operation of the MSBS Grot Version A0 it was found that its design required several modifications which would specifically improve the ergonomics of the assault rifle. In 2018, the engineers at FB Radom and WAT recommended to the Military Ordnance Utility (and which recommendations it approved) that the quick-release side rail of the handguard be provided with a QD port for a carrying sling and the existing LH and RH charging handle covers, which often suffered from damage, be replaced with an alternative solution of higher durability.

As a result of the design and process engineering work and the verification tests of the proposed solutions, FB Radom presented the MSBS Grot Version A1 (Fig. 3) the side rail of which features a QD port (Fig. 4) and a charging handle with a single universal cover, which is 9.5 mm thick and features a symmetrical mounting groove (Fig. 5).



Fig. 3. Modifications committed to the MSBS Grot calibre 5.56 mm standard (basic) assault rifle, version A1: right-hand view (top image); left-hand view (bottom image):
1 – side rail with a carrying sling QD port; 2 – heavy-duty universal cover of the charging handle, fits RH and LH sides

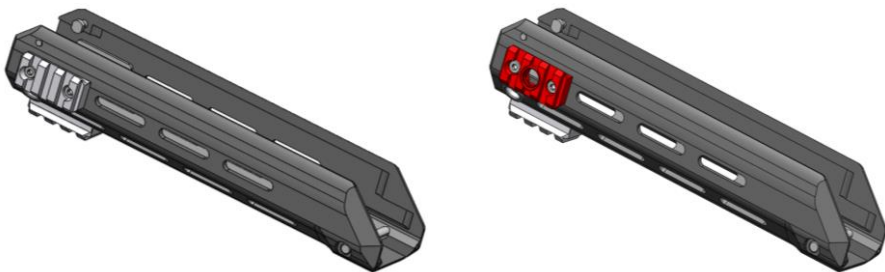


Fig. 4. The handguard with the rail of the MSBS GROT Version A0 (left image) and the handguard with a QD-port side rail for the carrying strap installed on the MSBS GROT Version A1 (right image)

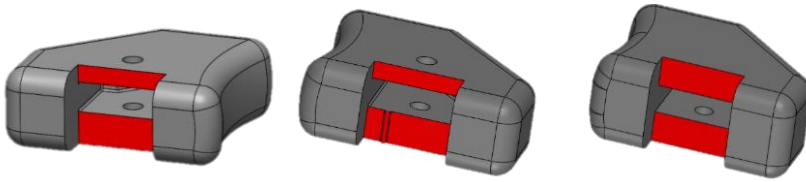


Fig. 5. LH and RH carrier charging handle covers (8 mm thick) with an asymmetrical mounting groove for the charging handle in the MSBS Grot Version A0 (left image) and the single universal carrier charging handle cover (9.5 mm thick) with the symmetrical mounting groove in the MSBS Grot Version A1

4. MSBS GROT VERSION A2 ASSAULT RIFLE

In 2019, as a result of more requests fed back from the operation of MSBS Grot, it was decided to design a modification to create Version A2 (Fig. 6).

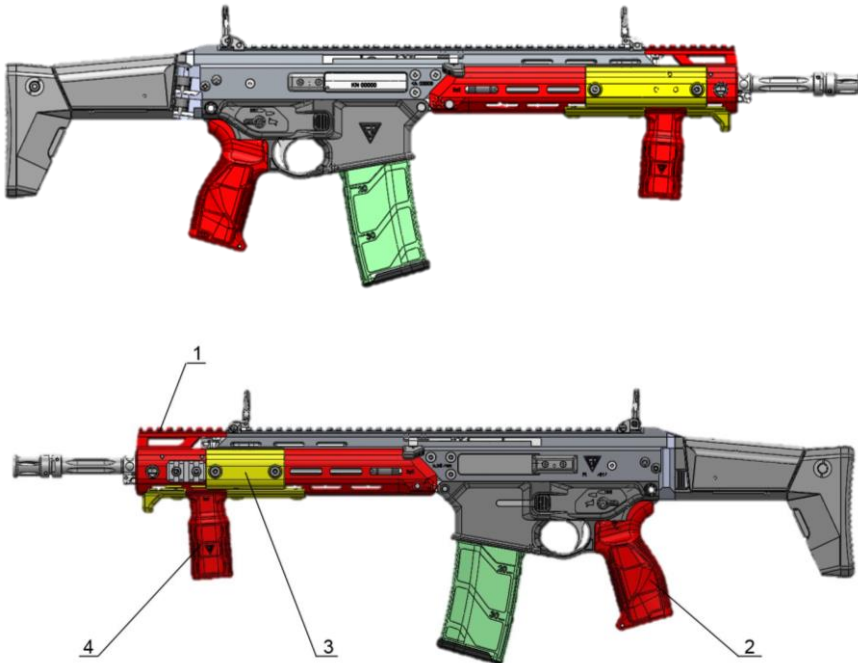


Fig. 6. Modifications committed to the MSBS Grot calibre 5.56 mm standard (basic) assault rifle, version A2: right-hand view (top image); left-hand view (bottom image): 1 – extended handguard (M-LOK) which protects the gas assembly and allows resting the rifle on it instead on the barrel while firing; 2 – FB Radom’s pistol grip (with an AR-standard attachment and the grip angle reduced from 25° to 15°); 3 – handguard safety panels for protection of the operator’s hands against overheating during intense firing; 4 – FB Radom front grip, mounted directly on the handguard (M-LOK attachment).

The design work, backed by all-embracing design and process engineering analyses, theoretical tests, and experimental tests (including utility testing), was completed at the beginning of 2020. The modifications committed to the assault rifle were as follows:

- A heavy-duty firing pin (which was in great demand due to intense dry fire training), which forced the development of a slightly revised construction of the bolt assembly (Fig. 7);

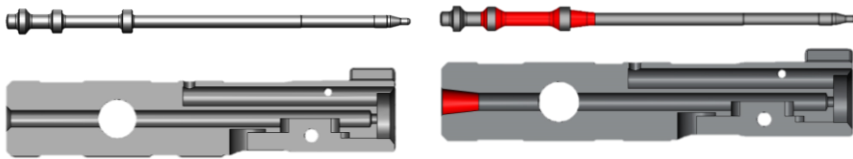


Fig. 7. Firing pin and bolt assembly of the MSBS GROT Version A0 and A1 (left image) and the firing pin and bolt assembly of the MSBS GROT Version A2 (right image)

- An extended M-LOK system handguard (versions A0 and A1 featured the MOE standard) (Fig. 8) to guard the gas assembly and the gas regulator against inadvertent loss of setting or even loss of the component, and to allow resting the rifle on its handguard (and not the barrel) while firing;



Fig. 8. Front grip and handguard of the MSBS GROT Version A1 (left image) and the front grip and handguard of MSBS GROT Version A2 (right image)

- A front grip (Fig. 8) manufactured by FB Radom and mounted directly on the handguard via M-LOK;
- A pistol grip (Fig. 9) manufactured by FB Radom with a lower angle (modified from 25° to 15°) to improve the convenience of operating the rifle's actuators and an AR-standard attachment;

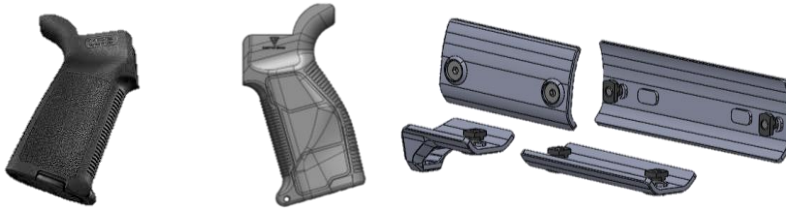


Fig. 9. Pistol grip of the MSBS GROT Version A1 (left image) and the pistol grip and handguard safety panels of the MSBS GROT Version A2 (right image)

- Handguard safety panels (Fig. 9) for protection of the operator's hands against heat during intense firing;
- A two-point carrying sling, the design of which was simplified by eliminating the one-point attachment to the rifle and with the front webbing made longer to increase length adjustment (Fig. 10).

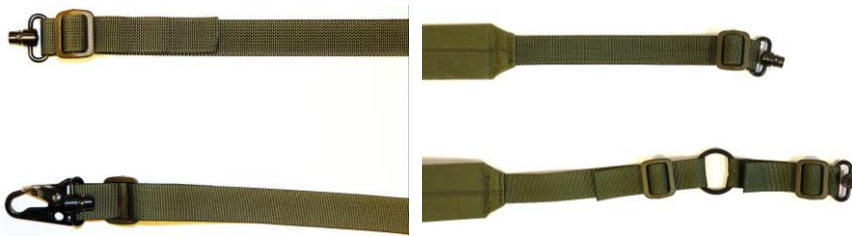


Fig. 10. Two-point carrying sling of the MSBS GROT Version A2 (top image) and the 1/2-point carrying strap of the MSBS GROT Version A1 (bottom image)

The MSBS Grot Version A2 assault rifle passed the regulatory testing at the Laboratory of Firearms and Shielding of the Military Institute of Armament Technology in Zielonka (Poland) (ref. Test Certificate no. 16/2020-20/B3/2020/B34/08/004 of 05/06/2020), and it is planned for deployment in the military in the second half of 2020.

5. POTENTIAL AVENUES FOR DEVELOPMENT OF THE MSBS GROT VERSION A2 ASSAULT RIFLE

Once the development of the MSBS Grot Version A2 was completed, FB Radom and MUT closely cooperated with the TDF Command, the Office of Chiefs of the Armament and Electronic Equipment Services at the Armed Forces Support Inspectorate, the “Nil” Military Unit, and the 3rd RMR to continue the analysis of the design engineering, process engineering, and operations of the rifle to seek future improvements in the face of the growing requirements and expectations of Polish Armed Force operators. Special attention of the research, design and process engineering team at FB Radom and MUT is given to the following areas:

- Overall weight reduction.
- Improved firing accuracy.
- Elimination of certain operational issues by development and testing of new construction component solutions for the rifle.
- Implementation of new surface/finish coating processes to improve the corrosion resistance of metal parts.
- Development of new modules and accessories to improve the performance value of the rifle (e.g. adjustable mechanical sights).

6. SUMMARY AND CONCLUSIONS

1. The deployment of the MSBS Grot calibre 5.56 mm assault rifle for use by the Polish Armed Forces was an event of great significance to Polish science and engineering, represented by the Institute of Armament Technology, Faculty of Mechatronics, Armament and Aerospace Technology at the Military University of Technology in Warsaw and the Polish defence industry, represented by Fabryka Broni “Łucznik”-Radom Sp. z o.o., a subsidiary of Polska Grupa Zbrojeniowa S.A.
2. The design and process engineering improvements of the MSBS Grot assault rifle from version A0 to version A2 is an embodiment of the mission shared by MUT and FB Radom: to make the best product for the Polish Armed Forces, with active contribution and feedback from the Polish military operators (represented by the “Nil” Military Unit and TDF), to whose current and future operational needs the firearm is being and will be adapted. The process is inextricable to all-embracing theoretical analysis (which often uses advanced computer-assisted engineering software) and experimental testing of the proposed solutions of improvement.

3. The design and process engineering improvements of the MSBS Grot calibre 5.56 mm assault rifle from version A0 to version A2 would not be possible without the contribution of the “Nil” Military Unit and the 3rd RMR, especially the TDF Command who, acting as the Military Ordnance Utility, was very enthusiastic and constructive in cooperation with FB Radom and MUT to improve the MSBS Grot as required by Polish soldiers.
4. The design optimisation process of the MSBS Grot calibre 5.56 mm assault rifle is not complete. Avenues of future cooperation on the improvement of the weapon to version A3 were defined. The contributing factors of this development are the good preliminary test results of the MSBS 5.56 mm assault rifles under Project RAWAT and the regular meeting of the TDF Command, the “Nil” Military Unit, the 3rd RMR, MUT, and FB Radom to discuss all operating aspects of the assault rifle. The format of the meetings has been highly appreciated both by the CEOs of FB Radom and the top management of MUT, as it delivers extremely important and expected results.
5. Over 35,000 units of the MSBS Grot assault rifle have been produced so far and their operators give positive feedback. It is a great argument for the firearm makers, design engineers, process engineers, technicians, shop floor workers, and all other employees holding a stake in the complex process of design and process engineering, production, administration and marketing efforts to continue their work on the improvement of the MSBS Grot assault rifle. The continued improvement of this weapon is aligned with the interest of its creators at FB Radom and MUT, as well as the Polish Armed Forces, especially the Polish soldiers. It should be remembered that a soldier often evaluates the potential of his or her weapons by comparison to the personal weapon, or the Grot assault rifle in this case, a rifle designed and made in Poland.
6. The conclusions from the extensive operation of the MSBS Grot assault rifle provide a suggestion that in parallel with the improvement of the rifle, the Polish-made intermediate cartridges should be perfected (including their blank versions), which would be done best by adaptation to the NATO standards and development trends. The Polish manufacturer of the cartridges is MESKO S.A. (Poland) and has the required competencies to deliver on this requirement in compliance with the established technical and engineering levels, and with a relatively short lead time. It is critical to the Polish Armed Forces and the potential client base for the MSBS Grot assault rifle and its NATO-certified ammunition.

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Rozwój karabinka MSBS GROT od wersji A0 do wersji A2

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Streszczenie. W dniu 15 grudnia 2017 roku Fabryka Broni „Łucznik”-Radom Sp. z o.o. (FB Radom), wchodząca w skład Polskiej Grupy Zbrojeniowej S.A., dostarczyła Wojskom Obrony Terytorialnej pierwszą partię liczącą 1 000 sztuk 5,56 mm karabinków standardowych (podstawowych) MSBS GROT C 16 FB M1 (w tzw. wersji A0), początkując proces jego wprowadzania do uzbrojenia Sił Zbrojnych RP. Broń została opracowana przez polskich konstruktorów i technologów z FB Radom i Wojskowej Akademii Technicznej (WAT), którzy przez 2,5 roku użytkowania karabinków zbierali od żołnierzy – za pośrednictwem Gestora sprzętu wojskowego (SpW) – doświadczenia, propozycje i uwagi z eksploatacji. Były one wnikliwie analizowane i dyskutowane podczas cyklicznych spotkań z udziałem przedstawicieli: Dowództwa Wojsk Obrony Terytorialnej, Dowództwa Komponentu Wojsk Specjalnych, 3 Rejonowego Przedstawicielstwa Wojskowego, WAT i FB Radom. Na podstawie podjętych wniosków oraz wyników przeprowadzonych badań teoretycznych i instrumentalnych proponowanych do zastosowania rozwiązań, karabinka MSBS GROT konsekwentnie udoskonalano, uzyskując obecnie broń w wersji A2. W pracy przedstawiono konstrukcję karabinka MSBS GROT w wersji A0 oraz zmiany konstrukcyjno-technologiczne jakie w nim wprowadzono, uzyskując wersję A1, a następnie wersję A2. Podczas prac optymalizacyjnych, popartych badaniami teoretycznymi i instrumentalnymi, szczególną uwagę zwrócono na zapewnienie wysokiego bezpieczeństwa użytkowania i niezawodności działania oraz pożądanej ergonomii karabinka w różnych warunkach eksploatacji. Ponadto zaprezentowano kierunki dalszych, możliwych udoskonaleń karabinka MSBS GROT.

Słowa kluczowe: mechanika, broń, broń palna, broń strzelecka, karabinek