MODERN SNIPER RIFLES IN THE ARMAMENT OF THE SERBIAN ARMED FORCES

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Summary:

The paper describes sniper rifles and optical sights in use in the Serbian Armed Forces. For the purpose of possible design of an optical sight that would meet modern technical and technological standards and needs of the Serbian Armed Forces, the paper analyzes the optical and mechanical characteristics of the aforementioned.

Key words: small arms, sniper rifle, caliber, optical sight, optics, magnification, reticle, rectification adjustment, surface protection, mounting on weapons.

Introduction

The subject of this paper is a presentation of modern sniper rifles with appropriate optical sighting devices used in the infantry units of the

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Serbian Armed Forces and special units for anti-terrorist activities of the units of the Ministry of Internal Affairs. The paper presents these optical sights and the parameters that characterize their construction and use. Optical sights will be analyzed from several aspects such as: possibilities of use, marksman's needs, construction, trend of use and price. The paper compares the sniper rifles and the optical sights used in the units of the Serbian Armed Forces.

In the armament of the Serbian Armed Forces, optical sights inherited from the period of the former Yugoslav People's Army (in Serbian: JNA) are still present, while only certain specialized units of the Army and the Police are equipped with more modern infantry weapons and, consequently, adequate optical sights.

Description of the weapons of the Serbian armed forces using optical sights

For the purpose of a successful comparative analysis of optical sights, this paper deals with the sights that were in use, the ones currently in use, as well as the ones that are in use in the countries in the region and the countries that rank among most technologically developed; it also gives the tactical - technical characteristics of infantry small arms onto which they are mounted. The optical sights used in the Serbian Armed Forces (and JNA) have been so far: the M76 optical sight for the 7.9 mm semi-automatic sniper rifle M76, and the optical sight M94 for the Black Arrow.

For the purpose of an adequate analysis, certain data for these infantry weapons will be given in the paper, while the tabulation of publicly available data will be presented at the very end. Based on the aforementioned, some proposals will be made for the selection of a sniper rifle and an optical sight that will ensure better execution of marksman's tasks.

The Zastava 7.9 mm semi-automatic sniper rifle M76 (Wikipedia Contributors, 2018) is a 7.92 x 57 mm Mauzer rifle of domestic production. The rifle is designed as a platoon sniper, or, in the western military nomenclature, as a designated marksman rifle. The concept of this sniper rifle comes from the Soviet military doctrine in which this type of weapon is different from real sniper rifles of high precision. It was officially introduced into the armament of the JNA in 1976, but the massive equipping of units began in the early eighties. This recoil-operated rifle was designed and produced by the company Zavod

Crvena Zastava, today Zastava Oružje from Kragujevac. The M76 sniper rifle was created on the basis of the Zastava M70 rifle, but longer and heavier, around the bullet 7.92 x 57 mm, with the optical sight M76 Zrak 4 x 5 ° 10 '(4 x 24) - a direct copy of the Soviet PSO-1 from the SVD rifle and an altered fire separator that allows only single firing. The longer barrel and the heavier round provide a significantly higher effective range compared to the M70, while the 7.92 mm round possesses considerably more favorable ballistic properties on the trajectory and, due to greater mass and higher velocity, has a much stronger effect on the target.

The basic tactical and technical characteristics of the 7.9 mm semi-automatic sniper rifle M76:

- Caliber: 7.92x57 mm
- Mass of the rifle without the optical sight: 4.6 kg
- Mass of the optical sight with the carrier: 0.65 kg
- Rifle length: 1135 mm
- Barrel length: 550 mm
- Number of grooves: 4
- Muzzle velocity: 730 m / s
- Magazine capacity: 10 rounds
- Maximum barrel gas pressure: 3200 bar

Figure 1 – Semi-automatic sniper rifle 7.9 mm Zastava M76 (Wikipedia Contributors, 2018)
Рис. 1 – Полуавтоматическая снайперская винтовка 7.9 мм Zastava M76 (Wikipedia Contributors, 2018)
Слика 1 – Полуаутоматска снајперска пушка 7,9 мм Застава М76 (Wikipedia Contributors, 2018)

It can effectively operate up to a distance of 1000 m, and optimally the best results are achieved within the range up to 800 m. For aiming, the ON M76 optical sight is used with a magnification of 4x and reticle

illumination, while a mechanical sight is also retained. At the beginning of the nineties, the M94 optical sight with a magnification of 6x was additionally developed, and the passive 5x80 sight can also be mounted on the rifle.

The Zastava M76 was manufactured in Iraq under Zastava licence on machines shipped from Yugoslavia in the 1980s in the 7.62 x 39 caliber under the name of the Tabuk sniper rifle. This rifle resembles the M76 a lot and features a black plastic ergonomic grip with a thumb pad of the Zastava design.

Black Arrow (Crna Strela) (Zastava arms, 2019) was produced in Serbia, at the Zavodi Crvena Zastava factory. The accuracy of the weapon changes with the number of rounds fired, and the test results have indicated so far that precision is reduced, but not necessarily, after 10,000 rounds fired. After ten to twenty thousand rounds fired, precision is reduced by approximately 10%.

Figure 2 – Sniper rifle Zastava M93 Black Arrow equipped with the M94 optical sight (Zastava arms, 2019)
Рис. 2 – Снайперская винтовка Застава М93 „Черная стрела” с оптическим прицелом М94 (Zastava arms, 2019)
Слика 2 – Снајперска пушка Застава М93 „Црна стрела” опремљена оптичким нишаном М94 (Zastava arms, 2019)

The M93 Black Arrow is intended for engaging targets in the open and in non-armoured vehicles at distances up to 1500m as well as for targets in light armoured vehicles and in concealment at distances up to 800m. In addition to destroying live force, the Black Arrow can also be used for targets such as non-armoured and light-armoured vehicles, grounded aircraft, radars and other electronic equipment, communication centers and command posts. It is also effective against enemy snipers. The Black Arrow has bolt action based on the Mauser system. The rifle was developed in two calibers - the Serbian Army uses the 12.7 x 108 mm caliber (Russian cartridge for heavy machine guns DŠK and NSV, while the exported version is customized with the 12.7 x 99 mm

American cartridge (Browning M2HB machine gun cartridge). The heavy barrel is made of chromium-nickel-vandium steel used for the production of cannon barrels. The feed system is the 5-round magazine.The recoil energy is reduced by placing a two-chamber gas brake on the muzzle and by installing two shock absorbers into the butt. The rifle is provided with the Zrak 8x56 M94 optical sight, and there are no mechanical sights. A bipod is mounted as well as a folding handle for easier carrying.

The basic characteristics of the Black Arrow:

- 12.7 x 108 mm round (developed in the former Soviet Union for SMK and NSV machine guns)
- feed – 5-round magazine,
- muzzle velocity - 888 m / s,
- mass - 16 kg,
- length - 1,670 mm,
- effective range - 1600m.

In relation to the previously described sniper rifle, certain structural improvements have been made to this one:

- it is much better balanced,
- butt with two shock absorbers,
- muzzle gas brake which makes firing easier (it reduces recoil to 62%),
- butt and cover are made of glass fiber reinforced polymer,
- folding bipod is adjustable depending on the size of the marksman's shelter,
- the Mauser system locking,
- the bolt has guides throughout its path in the carrier, and
- a heavy barrel provides a precise and accurate trajectory for a high-energy projectile.

In order to perform a comparative analysis of sniper rifles, this article will also mention sniper rifles currently in use in specialized units of the Serbian Armed Forces and Police.

Barrett M95 (Military-Today, 2018) is a sniper rifle designed by Barrett Firearms Manufacturing Company. It is an improved version of the Barrett M90. The most important difference is that the trigger grip has been moved slightly forward in order to make it easier to use. This weapon is lighter, more compact and easier to use than its older versions. The Barrett Company has announced that this sniper rifle is used in 15 countries, e.g. in Argentina, Austria, Denmark, Finland,

Greece, Georgia, Italy, Jordan, Malaysia, Philippines, Spain, Thailand, Turkey and some other countries. However, the sniper rifle Barrett M95 could never reach the popularity of the original Barrett M82, which is in standard use in nearly 60 countries.

The basic tactical and technical characteristics:

- caliber - 12.7 x 99 mm,
- weight - 10.7 kg,
- length – 1,143 mm,
- barrel length - 736 mm,
- muzzle velocity - 854 m / s,
- effective range - 1,000 m,
- maximum effective range of action – 1,800 m,
- accuracy - 1.5 - 2 MOA.

Figure 3 – Barrett M95 (Military-Today, 2018)
Рис. 3 – Barrett M95 (Military-Today, 2018)
Слика 3 – Barrett M95 (Military-Today, 2018)

Sako TRG (SAKO, 2018) represents a family of Finnish sniper rifles. It is intended for equipping military and special police units, and due to its exceptional precision, it is very suitable for anti-terrorist activities. Sako TRG rifles are considered to be among the best in the world in their class. In military and police units, they are generally available in 7.62x51mm caliber, as well as in .338 "Lapua Magnum." During exploitation, it proved to be an extremely high quality and reliable weapon in all conditions. The length is from 510 to 690 mm and it has 4 right twist grooves. The rifle has a high quality two-stage trigger mechanism and the trigger force can be adjusted in the range of 1 to 2.5 kg. The command lever of the brake is located inside the trigger guard. The stock is also fully adjustable and designed so that the rifle can also

be used by left-handed shooters. At the muzzle, there is an asymmetric gas brake which also serves as a flash suppressor. A silencer can be quickly and easily mounted on the gas brake. The rifle is fed by a 10-round box magazine and has a folding and removable bipod. It is delivered without a sight, and various optical, opto-electronic and backup mechanical sights can be mounted. In anti-terrorist units, Schmidt & Bender optics, 3-12x50, is most commonly used. In addition to the 7.62x51mm version, the rifle is produced in the calibers "300 Winchester Magnum" and "338 Lapua Magnum", under the TRG-41 label. Since 1999, TRG-22 (successor of the TRG-21) and TRG-42 (replacement for the TRG-22) have been manufactured with a different stock and some small improvements.

Several versions of this rifle have been created:

- **TRG-21** (1989) - original light version, 7.62x51mm,
- **TRG-22** (1999) - improved light version available in military 7.62x51mm and in civilian .260 Remington,
- **TRG-22A1** (2018) - advanced TRG-22, with a brand new redesigned stock. Available in military 7.62x51mm and in civil 6.5mm Creedmoor,
- **TRG-41** (1989) - original heavy version, in .338 Lapua Magnum and .300 Winchester Magnum,
- **TRG-42** (1999) - improved heavy version, available in .338 Lapua Magnum and .300 Winchester Magnum,
- **TRG-42A1** (2018) - advanced TRG-42, with a brand new redesigned stock,
- **Beretta TRG-42** (2008) - a civilian version for the US market, presented in 2008. It contains a folding stock and a short barrel, and is distributed by the Beretta USA company.

Figure 4 – Sako TRG 42 (SAKO, 2018)
Рис. 4 – Sako TRG 42 (SAKO, 2018)
Слика 4 – Sako TRG 42 (SAKO, 2018)

Tactical-technical characteristics:

Weight TRG-22: 4.7-4.9 kg	TRG-42: 5.1-5.3 kg
TRG-22 folding stock: 5.2 kg	TRG-42 folding stock: 5.8 kg
Length TRG-22 1,150 mm	TRG-42: 1,200mm
TRG-22 folding stock: 1.100 mm	TRG-42 folding stock: 1.020 mm
Barrel length TRG-22: 660 mm	TRG-42: 690 mm
TRG-22 folding stock: 510mm	TRG-42 folding stock: 510 mm
Caliber TRG-41 and TRG-42: .338 Lapua Magnum	TRG-21 and TRG-22: 7.62x51 mm
Type of operation Repetition	Action Bolt action
	Round velocity 900 m / s
Max. effective. range 400 m	Removable box magazine with 5, 7 and 10 rounds
Sight Optical	

Description of the optical sights used in the Serbian Armed Forces

Equipping the Serbian Armed Forces is well under way in accordance with the stated needs. Priority in the procurement of new equipment and weapons has been given to the specialized units of the Army. For example, the Special Brigade of the Serbian Armed Forces is equipped with some of the most modern optical sights such as Schmidt & Bender 3-12 x 50 and 4-16 x 50, Leupold and Swarovski 10 x 42, as well as with adequate sniper rifles.

ON-M76B optical sight

The ON-M76B optical sight (P.A. Distributing, 2018) is used for aiming at stationary, mobile, uncovered and camouflaged targets when firing form the sniper rifle 7.9 mm M76, 7.62 x 54, 7.62 x 51 (N), both in day and night time conditions, which ensures high accuracy when hitting small and distant targets during reduced visibility (twilight and dawn). The basic optical, mechanical and electrical characteristics are shown in the table.

Figure 5 – Optical sight M76B (P.A. Distributing, 2018)
Рис. 5 – Оптический прицел М76Б (P.A. Distributing, 2018)
Слика 5 – Оптички нишан М76Б (P.A. Distributing, 2018)

Table 1 – Technical-technological characteristics of the Zrak Sarajevo ON-M76B optical sight (Zrak d.d, 2016)
Таблица 1 – Технико-технологические характеристики оптического прицела „Зрак Сараево" ОН-М76Б (Zrak d.d, 2016)
Табела 1 – Техничко-технолошке карактеристике оптичког нишана „Зрак Сарајево" ОН-М76Б (Zrak d.d, 2016)

Zrak Sarajevo ON-M76B	
Dimensions	
Length	270 mm
Weight (mass)	0.450 kg
Optical data	
Magnification	4 x
Field of view	5º
Lens diameter	24 mm
Exit pupil diameter	6 mm
Exit pupil distance	77 mm
Resolution	10"
Diopter adjustment	od -0.7 do -0.5 dptr
Measuring scale for determining the distance to the standing human figure	od 200 do 800 m
Distance measuring	from 0 to 900 m, by turning the distance turret
Distance measuring	from 1000 m to 1100 m, by choosing the appropriate scale value on the reticle
Electrical data	
Reticle illumination	tritium-based

ON 6 x 32 optical sight

The ON 6 x 32 optical sight is used for aiming at stationary, moving, visible, and camouflaged targets when firing from the sniper rifle 7.62 x 51N, which ensures high accuracy when hitting small and distant targets. The basic optical, mechanical and electrical characteristics are shown in Table 2.

Table 2 – Technical-technological characteristics of the Zrak Sarajevo ON 6 x32 optical sight (Zrak d.d, 2016)
Таблица 2 – Технико-технологические характеристики оптического прицела „Зрак Сараево" ОН 6 x32 (Zrak d.d, 2016)
Табела 2 – Техничко-технолошке карактеристике оптичког нишана „Зрак Сарајево" ОН 6×32 (Zrak d.d, 2016)

Zrak Sarajevo ON 6 X 32	
Dimensions	
Length	270 mm
Weight (mass)	0.450 kg
Optical data	
Magnification	6 x
Field of view	4°
Lens diameter	32 mm
Exit pupil diameter	5.8 mm
Resolution	≤9"
Diopter adjustment	from -0.7 to -0.5 dptr
Distance measurement	from 0 to 900 m by turning the distance turret
	from 1000 m to 1100 m by taking the appropriate scale value on the reticle
Compensation	by turning the azimuth turret to the left and right 1-10 (10 milliradians)
	scale on the reticle to the left and right 1-10 (10 milliradians)
Electrical data	
Reticle illumination	tritium-based

ON 8 x 42 optical sight

The ON 8 x 42 optical sight (Zrak d.d, 2016) serves for aiming at stationary, moving, uncovered, and camouflaged targets with the 7.9 mm sniper rifle, thus achieving high accuracy when firing at small and distant

targets. The basic optical, mechanical and electrical characteristics are shown in Table 3.

Table 3 – Technical-technological characteristics of the Zrak Sarajevo ON 8 x42 optical sight (Zrak d.d, 2016)
Таблица 3 – Технико-технологические характеристики оптического прицела „Зрак Сараево" ОН 8 x42 (Zrak d.d, 2016)
Табела 3 – Техничко-технолошке карактеристике оптичког нишана „Зрак Сарајево" ОН 8×42 (Zrak d.d, 2016)

Zrak Sarajevo ON 8 X 42	
Dimensions	
Length	320 mm
Weight (mass)	0.480 kg
Optical data	
Magnification	8.2 x
Field of view	2.8º
Lens diameter	42 mm
Exit pupil diameter	5.13 mm
Resolution	≤7"
Dioptric adjustment	from -0.7 to -0.5 dptr
Distance measurement	from 0 to 900 m by turning the distance turret
	from 1000 m to 1200 m by taking the appropriate scale value on the reticle
Compensation	by turning the azimuth turret to the left and right 1-10 (10 milliradians)
	scale on the reticle to the left and right 1-10 (10 milliradians)
Electrical data	
Reticle illumination	tritium-based

ON-10 x 42 optical sight

The 10 x 42 optical sight (Teleoptik-Gyros, 2018a) is designed to aim at stationary, moving and detectable targets in daylight, reduced visibility and at night. This optical sight is useful for long range sniper rifles. It meets all the requirements for high accuracy at long distances, as well as for practical use in extreme climatic and terrain conditions. The range of movement changes is 60 MOA. The basic optical, mechanical and electrical characteristics are shown in Table 4.

Table 4 – Technical-technological characteristics of the Teleoptik ON-10 x 42 optical sight (Teleoptik-Gyros, 2018a)
Таблица 4 – Технико-технологические характеристики оптического прицела „Телеоптик" ОН- 10 х42 (Teleoptik-Gyros, 2018a)
Табела 4 – Техничко-технолошке карактеристике оптичког нишана „Телеоптик" ОН-10×42 (Teleoptik-Gyros, 2018a)

Teleoptik ON 10 X 42	
Dimensions	
Length	340 mm
Climate conditions	
Temperature range of operation	- 30ºC – + 55ºC
Optical data	
Magnification	10 x
Field of view	2º
Lens diameter	42 mm
Exit pupil diameter	4.2 mm
Exit pupil distance	85 mm
Resolution	7"
Diopter adjustment	± 2.5 diopters
Reticle	MilDot
Parallax	≤ 0.2 diopters
Electrical data	
Reticle illumination	tritium-based

Teleoptik ON 8 x 56

This optical sight is intended for long range 12.7mm sniper rifles. The ballistics of the distance detection and the reticle is at the request of the customer. The 8 x 56 optical sight (Teleoptik-Gyros, 2018b) is very reliable and guarantees long-term use in all climate conditions. Due to its advanced design and superb optics, the view is clear and well illuminated, which allows optimum viewing in conditions of insufficient visibility.

The reticle can be adjusted to the direction and elevation, ensuring the stability of the position chosen during rectification. The basic optical, mechanical and electrical characteristics are shown in Table 5.

Figure 6 – ON 8 x 56m optical sight (Teleoptik-Gyros, 2018b)
Рис. 6 – Оптический прицел ОН 8 x 56м (Teleoptik-Gyros, 2018b)
Слика 6 – Оптички нишан ОН 8×56м (Teleoptik-Gyros, 2018b)

Table 5 – Technical-technological characteristics of the Teleoptik ON 8 x 56 optical sight (Teleoptik-Gyros, 2018b)
Таблица 5 – Технико-технологические характеристики оптического прицела „Телеоптик" ОН- 8 x56 (Teleoptik-Gyros, 2018b)
Табела 5 – Техничко-технолошке карактеристике оптичког нишана „Телеоптик" ОН 8×56 (Teleoptik-Gyros, 2018b)

Teleoptik ON 8 X 56	
Dimensions	
Length	400 mm
Height, width	63.5 mm
Weight (mass)	0.850 kg
Climate conditions	
Temperature range of operation	- 30ºC – + 55ºC
Optical data	
Magnification	8 x
Field of view	3º
Lens diameter	56 mm
Exit pupil diameter	7 mm
Exit pupil distance	75 mm
Diopter adjustment	± 2.5 diopters
Electrical data	
Reticle illumination	tritium-based

Schmidt&Bender 3-12x50 and 4-16x50 sights

The Schmidt & Bender 3-12x50 and 4-16x50 sights (Schmidt&Bender, 2016) are intended for shooting at individual stationary and moving targets, uncovered or camouflaged, in daytime and under poor visibility conditions. The optical sight enables high accuracy when aiming at small and distant targets in unfavorable visibility conditions. Thanks to reticle illumination, it is possible to shoot at twilight and in a clear night with a full moon.

The reticle of the optical sight enables:

– aiming,
– distance detection,
– elevation adjustment from 0 to 13 milliradians (mil), and
– left-right compensation in the range of 0 to 10 milliradians on the turret and from 0 to 5 mils on the reticle scale on each side.

The optical sight consists of:

– mechanical circuits and
– optical circuits.

The mechanical circuits are:

– mechanism of elevation,
– mechanism of direction,
– mechanism of parallax, and
– reticle illumination system.

The optical circuits are:

– objective lens,
– rotating lens system,
– eyepiece, and
– reticle.

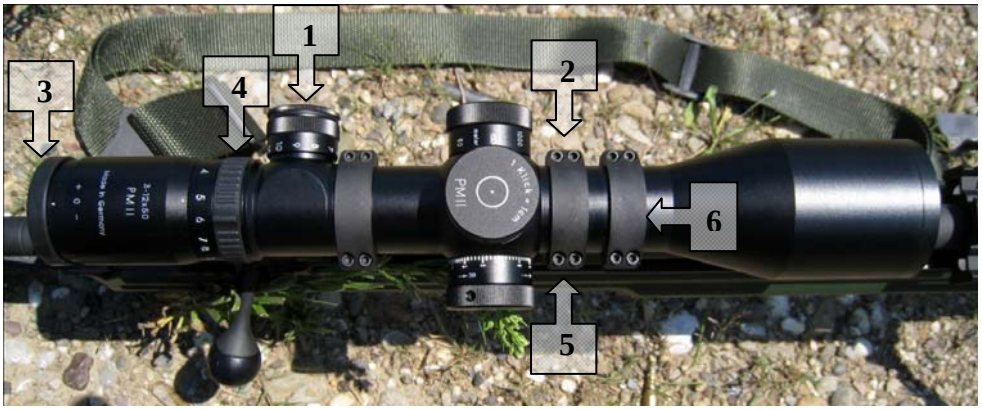

Figure 7 – Optical sight: 1. system for reticle illumination, 2. parallax mechanism, 3. diopter adjustment ring, 4. magnification adjustment ring, 5. elevation mechanism, and 6. direction mehanism (Schmidt&Bender, 2016)
Рис. 7 – Оптический прицел: 1) система подсветки сетки, 2) механизм учета поправки на параллакс, 3) кольцо регулировки диоптрий, 4) кольцо регулировки кратности, 5) механизм вертикальной корректуры и 6) механизм выверки прицела по направлению (Schmidt&Bender, 2016)
Слика 7 – Оптички нишан: 1. систем за осветљење кончанице, 2. механизам паралакса, 3. прстен за диоптријско изоштравање, 4. прстен за подешавање увећања, 5. механизам елевације, 6. механизам правца (Schmidt&Bender, 2016)

The basic optical, mechanical and electrical characteristics are shown in the table.

Table 6 – Technical-technological characteristics of the Schmidt & Bender 3-12x50 PM II P optical sight (Schmidt&Bender, 2016), (Serbian Armed Forces, 2016)
Таблица 6 – Технико-технологические характеристики оптического прицела Schmidt & Bender 3-12x50 PM II P (Schmidt&Bender, 2016), (Serbian Armed Forces, 2016)
Табела 6 – Техничко-технолошке карактеристике оптичког нишана Schmidt & Bender 3-12×50 PM II P (Schmidt&Bender, 2016), (Serbian Armed Forces, 2016)

Schmidt&Bender 3-12x50 PM II P	
Mechanical characteristics	
Casing material	It is made of one piece of aluminum alloy
Surface protection	Anodised casing in matte finish, scratch-proof
Lens protectors	The eyepiece lens is protected by a rubber cover from scratches
Rectification adjustment	One click value is 0.1 mil (1cm per 100m)
Mounting	Mechanical compatibility according to MIL-STD-1913 standard (picatinny or weaver rails)

Schmidt&Bender 3-12x50 PM II P	
Dimensions	
Length	343 mm
Weight (mass)	0.866 kg
Climate conditions	
Temperature range of operation	- 40ºC – + 65ºC
Resistance to immersion	Waterproof
Sealing	300mbar internal pressure
Optical data	
System	Magnification adjustment with the rotation ring, the reticle center elevation is ¼ MOA
Magnification	3-12x (variable magnification)
Field of view	11.1 m - 3.4 m at 100 m and 6.3 ° to 2.5 °
Lens diameter	50 mm
Exit pupil diameter	14.3 mm - 4.3 mm
Exit pupil distance	90 mm
Diopter adjustment	od +2 do -3 dptr
Elevation adjustment - cm / 100m (turret + recitle)	200
Direction adjustment - cm / 100m (turret + reticle)	+/-100
Parallax adjustment	50m bis ∞
Illumination intensity	0-11
Illumination timer	6 h
Reticle	Illuminated Mil-Dot reticle, P3L type
Optical layers	Anti-reflective layers for visible light on all optical surfaces
Electrical data	
Battery type	Battery (CR 2032/3V)
Average battery life	100 hours

Table 7 – Technical-technological characteristics of the Schmidt & Bender 4-16x50 PM II LP optical sight (Schmidt&Bender, 2016), (Serbian Armed Forces, 2016)
Таблица 7 – Технико-технологические характеристики оптического прицела Schmidt & Bender 3-12x50 PM II P (Schmidt&Bender, 2016), (Serbian Armed Forces, 2016)
Табела 7 – Техничко-технолошке карактеристике оптичког нишана Schmidt&Bender 3-12×50 PM II P (Schmidt&Bender, 2016), (Serbian Armed Forces, 2016)

Schmidt&Bender 4-16x50 PM II P	
Mechanical characteristics	
Casing material	It is made of one piece of aluminum alloy

Schmidt&Bender 4-16x50 PM II P	
Surface protection	Anodised casing in matte finish, scratch-proof
Lens protectors	The eyepiece lens is protected by a rubber cover from scratches
Rectification adjustment	One click value is 0.1 mil (1cm per 100m)
Mounting	Mechanical compatibility according to MIL-STD-1913 standard (picatinny or weaver rails)
Dimensions	
Length	393 mm
Weight (mass)	0.933 kg
Climate conditions	
Temperature range of operation	- 40ºC – + 65ºC
Resistance to immersion	Waterproof
Sealing	300mbar internal pressure
Optical data	
System	Magnification adjustment with the rotation ring, the reticle center elevation is ¼ MOA
Magnification	4-16 x (variable magnification)
Field of view	7.5 m - 2.4 m at 100 m and 4.3 ° to 1.4 °
Lens diameter	50 mm
Exit pupil diameter	12.5 mm to 3.1 mm
Exit pupil distance	90 mm
Diopter adjustment	od +2 to -3 dptr
Elevation adjustment - cm / 100m (turret + recitle)	200
Direction adjustment - cm / 100m (turret + recitle)	+/-75
Parallax adjustment	50m bis ∞
Illumination intensity	0-11
Illumination timer	6 h
Reticle	Illuminated Mil-Dot finish, P3L type
Optical layers	Anti-reflective layers for visible light on all optical surfaces
Electrical data	
Battery type	Battery (CR 2032/3V)
Average battery life	100 hours

Leupold sight

The Leupold 4.5-14 x 50 Mark 4 ER / T M1 Side Focus Riflescope (Leupold, 2018) is designed for long distance aiming. This optical sight has a large 50 mm diameter lens that captures more light in very low light conditions and provides clear and crisp view. The DiamondCoat 2 protective coatings on the external surfaces of optical elements protects against scratches and other mechanical damage. The optical sight offers adjustment for windage and ballistic drop of rounds within the range of 100 MOA and elevation adjustment with a correction of 1/4 MOA mil-dots.

The reticle provides a total range of 60 MOA for the round. The casing is made of 6061-T6 aluminum alloy which is durable and waterproof. In order to eliminate the effects of thermal shock and reduce blurring while in the environment with temperature changes, the casing is filled with a mixture of krypton and argon gases. The basic optical, mechanical and electrical characteristics are shown in the table.

Figure 8 – Leupold Mark4 4.5-14x50 Side Focus CDS optical sight
Рис. 8 – Оптический прицел Leupold Mark4 4.5-14x50 Side Focus CDS
Слика 8 – Оптички нишан Leupold Mark4 4.5-14×50 Side Focus CDS

Table 8 – Technical and technological characteristics of the Leupold Mark4 4.5-14x50 Side Focus optical sight (Leupold, 2018)
Таблица 8 – Технико-технологические характеристики оптического прицела Leupold Mark4 4.5-14x50 Side Focus (Leupold, 2018)
Табела 8 – Техничко-технолошке карактеристике оптичког нишана Leupold Mark4 4.5-14×50 Side Focus (Leupold, 2018)

Leupold Mark4 4.5-14x50 Side Focus CDS	
Mechanical characteristics	
Casing material	It is made of 6061-T6 aluminum alloy
Surface protection	Anodization in matte black
Lens protectors	The eyepiece lens is protected by a rubber cover from scratches

Leupold Mark4 4.5-14x50 Side Focus CDS	
Rectification adjustment	One click is 1/4 MOA (1cm per 100m), for elevation 110 MOA and for windage 15 MOA
Mounting	Mechanical compatibility according to MIL-STD-1913 standard (picatinny or weaver rails)
Dimensions	
Length	312 mm
Weight (mass)	0.482 kg
Climate conditions	
Temperature range of operation	- 40ºC – + 65ºC
Resistance to immersion	Waterproof
Optical data	
Magnification	4.5-14x
Field of view	6.82 m to 2.53 m at 100 m or 3.9 ° to 1.45 °
Lens diameter	50 mm
Exit pupil diameter	from 11.1 mm to 3.6 mm
Exit pupil distance	98 mm
Reticle	Duplex
Optical layers	Anti-reflective layers for visible light on all optical surfaces
Electrical data	
Battery type	Battery (CR 2032/3V)

Swarovski sight

The Swarovski 1.7- 10x42 L sight (Swarovski Optik, 2018) shows its good performance on the battlefield. It provides quick action to shooters. This sight is modest in size and weight, made of aluminum alloy. Its large field of view shows its quality. The basic optical, mechanical and electrical characteristics are shown in the table.

Figure 9 – Swarovski 1.7- 10x42 L optical sight (Swarovski Optik, 2018)
Рис. 9 – Оптический прицел Swarovski 1.7- 10x42 L (Swarovski Optik, 2018)
Слика 9 – Оптички нишан Swarovski 1.7- 10x42 L (Swarovski Optik, 2018)

Table 9 – Technical-technological characteristics of the Swarovski 1.7- 10x42 L optical sight (Swarovski Optik, 2018)
Таблица 9 – Технико-технологические характеристики оптического прицела Swarovski 1.7- 10x42 L (Swarovski Optik, 2018)
Табела 9 – Техничко-технолошке карактеристике оптичког нишана Swarovski 1.7- 10×42 L (Swarovski Optik, 2018)

Swarovski 1.7- 10x42 L	
Mechanical characteristics	
Casing material	It is made of one piece of aluminum alloy
Surface protection	Anodised casing in matte finish, scratch-proof
Lens protectors	The eyepiece lens is protected by rubber
Rectification adjustment	One click is 1/4 MOA (1cm per 100m)
Mounting	Mechanical compatibility according to MIL-STD-1913 standard (picatinny or weaver rails)
Dimensions	
Length	324 mm
Weight (mass)	0.490 kg
Climate conditions	
Temperature range of operation	- 20ºC – + 50ºC
Resistance to immersion	Waterproof
Optical data	
Magnification	1.7-10x
Field of view	14.3° do 2.4°
Lens diameter	42 mm
Exit pupil diameter	9.6 mm to 4.2 mm
Exit pupil distance	95 mm
Diopter adjustment	od +2 do -3 dptr
Reticle	Mil-Dot reticle, 4A-I type
Optical layers	Anti-reflective layers for visible light on all optical surfaces
Electrical data	
Battery type	Battery (CR 2032/3V)

POSP 8 x 42 sight

The POSP 8 x 42 sight (Binoculars from Russia, 2018) is an upgraded version of the POSP -1 optical sight. The main difference between these two scopes is magnification increase, from 4 to 8 x. The POSP 8 x 42 is particularly effective when shooting at small and well-

camouflaged targets. It enables distance measurement to the destination, as well as the introduction of lateral corrections and operation under reduced visibility conditions. The POSP 8 x 42 optical sight is hermetically sealed and filled with nitrogen so that it does not get blurred when used during frequent temperature changes.

Figure 10 – POSP 8 x 42 optical sight (Binoculars from Russia, 2018)
Рис. 10 – Оптический прицел POSP 8 x 42 (Binoculars from Russia, 2018)
Слика 10 – Оптички нишан POSP 8×42 (Binoculars from Russia, 2018)

Table 10 – Technical-technological characteristics of the POSP 8 x 42 optical sight (Binoculars from Russia, 2018)
Таблица 10 – Технико-технологические характеристики оптического прицела POSP 8 x 42 (Binoculars from Russia, 2018)
Табела 10 – Техничко-технолошке карактеристике оптичког нишана POSP 8×42 (Binoculars from Russia, 2018)

POSP 8 x 42	
Dimensions	
Length	380 mm
Weight (mass)	0.700 kg
Climate conditions	
Temperature range of operation	- 50ºC – + 50ºC
Resistance to immersion	Waterproof
Optical data	
Magnification	8 x
Field of view	13°
Lens diameter	40 mm

POSP 8 x 42	
Exit pupil diameter	5 mm
Exit pupil distance	75 mm
Optical layers	Anti-reflective layers for visible light on all optical surfaces

Comparative analysis of the long range sniper rifles used in the Serbian Armed Forces

For the purpose of a qualitative and quantitative analysis of the sniper rifles used in the Serbian Armed Forces, the table (Table 11) will show the data of the rifles of similar tactical-technical characteristics. The 7.9 mm semi-automatic sniper rifle M76 will not be taken into consideration, as it is considered outdated.

Table 11 – Technical-technological characteristics of the sniper rifles in use in the Serbian Armed Forces
Таблица 11 – Технико-технологические характеристики снайперских винтовок, используемых Вооруженными силами Республики Сербия
Табела 11 – Техничко-технолошке карактеристике снајперских пушака које се налазе у опреми Војске Србије

	Mass	Length	Barrel length	Caliber	Round velocity	Range	Maximum effective range of action	Sight
Black arrow	16 kg	1670 mm	1007 mm	12.7x108 mm	888 m/s	1600 m	1800 m	Optical M94
Barrett 95	10.7 kg	1143 mm	736 mm	12.7x99 mm	854 m/s	1000 m	1800 m	More types
Sako TRG 22-42	4.7-5.8 kg	1150-1200 mm	660-690 mm	7.62x51 mm	900 m/s	400 m	1000m	More types

Comparative analysis of the optical sights used in the Serbian Armed Forces

For the purpose of a qualitative and quantitative analysis of the optical sights in use in the Serbian Armed Forces, the tabular data of these optical sights with their tactical and technical characteristics will be presented. The Zrak Sarajevo ON M-76B and ON 6 x 32 optical sights will not be taken into consideration because they are outdated and already replaced with more technologically advanced optical sights.

Only technical and technological parameters relevant for quality use and maintenance of optical sights will be taken into consideration. The analysis of the optical sights is shown in two tables. In Table 12, the optical and mechanical characteristics of the optical sights with fixed magnification are shown, while the optical and mechanical characteristics of the optical sights with variable magnification are presented in Table 13.

Table 12 – Optical and mechanical characteristics of the optical sights with fixed magnification
Таблица 12 – Оптические и механические характеристики прицела с фиксированной кратностью
Табела 12 – Оптичке и механичке карактеристике оптичких нишана са фиксним увећањем

	Teleoptik ON 8 x 56	Zrak Sarajevo ON 8 x 42	Teleoptik ON 10 x 42	POSP 8 x 42
Magnification	8 x	8,2 x	10 x	8 x
Field of view	3º	2.8º	2 º	13º
Lens diameter	56 mm	42 mm	42 mm	40 mm
Exit pupil diameter	7 mm	5.13 mm	4.2 mm	5 mm
Exit pupil distance	-	-	85 mm	75 mm
Diopter adjustment	± 2.5	-0.7 -0.5	±2.5	-
Length	400 mm	320 mm	340 mm	380 mm
Weight (mass)	0.850 kg	0.480 kg	-	0.700 kg

Note:
- No data was found for the indicated optical sight.

Table 13 – Optical and mechanical characteristics of the optical sights with variable magnification
Таблица 13 – Оптические и механические характеристики прицела с переменной кратностью
Табела 13 – Оптичке и механичке карактеристике оптичких нишана са променљивим увећањем

	Swarovski 1.7- 10x42 L	Leupold Mark4 4.5-14x50 Side Focus CDS	Schmidt&Bender 4-16x50 PM II P	Schmidt&Bender 3-12x50 PM II P
Magnification	1.7-10 x	4.5-14 x	4-16 x	3-12 x
Field of view	14.3-2.4º	3.9-1.45º	4.3-1.4º	6.3-2.5º
Lens diameter	42 mm	50 mm	50 mm	50 mm
Exit pupil diameter	9.6-4.2 mm	11.1-3.6 mm	12.5-3.1 mm	14.3-4.3 mm

	Swarovski 1.7- 10x42 L	Leupold Mark4 4.5-14x50 Side Focus CDS	Schmidt&Bender 4-16x50 PM II P	Schmidt&Bender 3-12x50 PM II P
Exit pupil distance	95 mm	98 mm	90 mm	90 mm
Diopter adjustment	+2 - -3	-	+2 - -3	+2 - -3
Length	324 mm	312 mm	393 mm	343 mm
Weight (mass)	0.490 kg	0.482 kg	0.933 kg	0.866 kg

Note:
- No data was found for the indicated optical sight.

Conclusion

The paper presents an overview of the tactical-technical-technological characteristics of the sniper rifles in use in the Serbian Armed Forces. The Black Arrow sniper rifle (produced in the Crvena Zastava factory in Kragujevac) is described as well as sniper rifles of foreign production, such as Barrett 95 (American manufacturer Barrett Firearms Manufacturing Company) and Sako TRG 22-42 (Finnish manufacturer Sako Limited). In addition to the sniper rifles, the paper provides a detailed overview of the optical and mechanical characteristics of the optical sights mounted on the mentioned sniper rifles. A comparative analysis was made based on the manufacturers' data available to the general public.

Based on the comparative analysis, it was concluded that the Black Arrow sniper rifle does not lag behind the tactical-technical characteristics of foreign rifles shown in this paper; therefore, it can be modernized and its weight possibly reduced.

Regarding the comparative analysis of the optical sights, it can be concluded that the Serbian Armed Forces should initiate the procedure of designing a modern optical sight with variable magnification thus increasing a potential use of the Serbian Armed Forces in multinational operations.

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СОВРЕМЕННЫЕ СНАЙПЕРСКИЕ ВИНТОВКИ, ИСПОЛЬЗУЕМЫЕ ВООРУЖЕННЫМИ СИЛАМИ РЕСПУБЛИКИ СЕРБИЯ

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РУБРИКА ГРНТИ: 78.00.00 ВОЕННОЕ ДЕЛО;
78.25.00 Вооружение и военная техника
ВИД СТАТЬИ: профессиональная статья
ЯЗЫК СТАТЬИ: английский

Резюме:

В данной статье описаны снайперские винтовки и оптические прицелы, используемые Вооруженными силами Республики Сербия. В статье также приведен сравнительный анализ оптических и механических характеристик различных прицелов, с целью возможного проектирования оптического прицела,

соответствующего технико-технологическим стандартам и нуждам Вооруженных сил Республики Сербия.

Ключевые слова: стрелковое вооружение, снайперская винтовка, калибр, оптический прицел, оптика, кратность, сетка, центрирование, защитное покрытие, установка на оружие

САВРЕМЕНЕ СНАЈПЕРСКЕ ПУШКЕ У ОПРЕМИ ВОЈСКЕ СРБИЈЕ

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ОБЛАСТ: наоружање
ВРСТА ЧЛАНКА: стручни рад
ЈЕЗИК ЧЛАНКА: енглески

Сажетак:

У раду су представљене снајперске пушке и оптички нишани који се налазе у опреми Војске Србије. Ради евентуалног пројектовања оптичког нишана, који би задовољио савремене технички-технолошке стандарде и потребе Војске Србије, анализиране су оптичке и механичке карактеристике оптичких нишана.

Кључне речи: стрељачко наоружање, снајперска пушка, калибар, оптички нишан, оптика, увећање, кончаница, подешавање ректификације, површинска заштита, монтажа на оружје.

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