

Conversion kit for AK-47 automatic rifle in order to fire 5.56*45mm NATO caliber instead of firing 7.62*39mm caliber

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Abstract— Nowadays, the automatic rifle is considered the most used weapon in armies all over the world. So, the need to increase rifle maneuverability arose. In this paper, an idea of modifying the AK-47 automatic rifle so that it can fire 7.62*39mm cartridge and 5.56*45 mm NATO cartridge, and changing the AK-47 automatic rifle from having a non-interchangeable barrel into an interchangeable barrel in combat action is proposed. The idea of changing the fired caliber has been applied in modern automatic rifles. The conversion kit consists of a barrel, breech block, and magazine. The barrel will have a securing pin for its removal, and the AR-15 style rifle will be used for a 5.56*45 mm NATO cartridge, but due to its construction, an adaptor is designed for making it compatible with the AK-47 automatic rifle. The procedures for assembly and disassembly are described. And a comparison between the two calibers and the benefit of having a conversion kit for automatic rifle AK-47 are shown.

Keywords—Conversion kit, Automatic Rifle, 7.62*39mm, AK-47, 5.56*45mm NATO, AR-15 rifle style magazine

I. INTRODUCTION

The automatic rifle is considered the most important weapon system in the world as it is the main armament for soldiers. The AK-47 automatic rifle, with more than 70 million pieces around the world, is considered the most used weapon system in the world, it has proved its durability and reliability in the most extreme conditions with very few malfunctions and easiness in repair and maintenance.

And to increase the manoeuvrability of the AK-47 automatic rifle, the idea of having a conversion kit for changing the fired caliber from 7.62*39 mm to 5.56*45 mm NATO arose, this also serves as this makes it capable to change the barrel of the AK-47 automatic rifle from a non-interchangeable barrel into an interchangeable barrel in combat action barrel, as there is no need for changing the weapon system or the weapon become out-of-order if shrapnel hit the barrel or the barrel bend due to combat action.

The idea of a conversion kit is applicable in many weapon systems around the world such as 1- ARX-160 where it changes the barrel, breech block, lower receiver assembly, and magazine for changing caliber as shown in Fig. 1 [1]. 2- CZ BREN 2 in which it could change between calibers 7.62*39 mm and 5.56*45 mm NATO by changing the barrel, gas block, breech block, and magazine.



Figure 1: ARX-160 Conversion kit

In this paper, a conversion kit for the AK-47 automatic rifle, from firing 7.62*39mm to firing 5.56*45mm NATO, will be designed and an interchangeable method for barrel assembly will be introduced, the breech block of AK-47 will be modified to fit for 5.56*45mm NATO cartridges, designing magazine adaptor for AR-15 style rifle magazine carrying 5.56*45mm NATO cartridges.

II. DESCRIPTION OF PROPOSED IDEA

To change the fired caliber, the barrel, breech block and magazine are to be changed for compatibility of firing 5.56*45mm NATO caliber [2].

The trunnion is to be modified to be capable of changing the barrel from 7.62*39mm to 5.56*45mm NATO and vice versa. A pin is inserted for easy release of the barrel and to secure it from moving while firing and to prevent its rotation due to projectile rotation inside the barrel.

The barrel of both calibers 7.62*39mm and 5.56*45mm NATO will have the iron front sight, gas chamber, and bottom hand guard lock attached to it.

The breech block must change as the cartridge case of both calibers 7.62*39mm and 5.56*45mm NATO has different kinds of rims and different dimensions.

Magazine compatible for each caliber is used.

A. The new Trunnion Calculations

In order to have different barrels adapted to the same weapon receiver, a way of disassembly and assembly must be designed.

A Pin, as shown in Fig. 2, is used for this task and for securing the barrel position during firing against both translation motion due to projectile motion inside the barrel and rotation motion due to projectile rotation due to engraving with rifling.

On having a barrel of sigma yield = 900 MPa, the pin will be taken of material of sigma yield = 800 MPa to make sure that if there is any wear it will be in the pin, not the barrel.

The designed pin must withstand a pressure of 300 MPa from a 7.62*39mm barrel and 330 MPa from a 5.56*45mm NATO barrel.

1) Shear Stress^[3]

$$F_{7.62} = P_{7.62} \times A_{7.62} = 300 \times 10^6 \times \pi/4 \times (7.62 \times 10^{-3})^2$$

$$13681 \text{ N}$$

$$F_{5.56} = P_{5.56} \times A_{5.56} = 330 \times 10^6 \times \pi/4 \times (5.56 \times 10^{-3})^2$$

$$8012 \text{ N}$$

Since $F_{7.62} > F_{5.56}$, $F_{7.62}$ is taken for further calculations

$$[\sigma_E] = 0.8 \cdot \sigma_y = 0.8 \cdot 800 = 640 \text{ MPa}$$

$$[\tau] = [\sigma] / 2 = 640 / 2 = 320 \text{ MPa}$$

$$[A_s] = F / [\tau] = 13681 / 320 \times 10^6$$

$$= 4.2753 \times 10^{-5} \text{ m}^2 = 42.75 \text{ mm}^2$$

Where F is powder force generated at point of maximum pressure (N), P is maximum pressure of powder gases inside barrel (Pa), A is cross-section area of barrel bore (m^2), subscript 7.62 and 5.56 represents 7.62*39mm and 5.56*45mm NATO projectile respectively, $[\sigma_E]$ is allowable elastic stress (MPa), σ_y is yield stress (MPa), $[\tau]$ is allowable

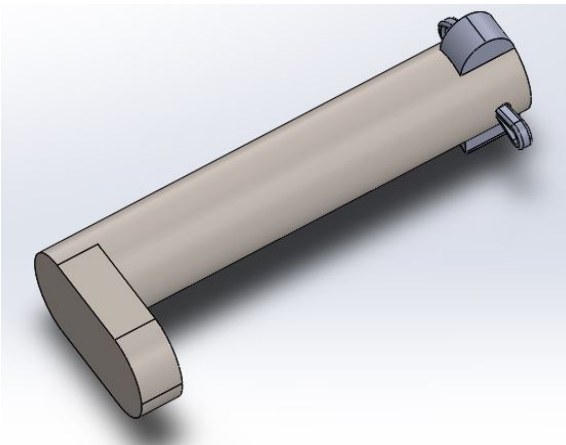


Figure 2: Changing pin with locking mechanism

shear stress (MPa), $[A_s]$ is required cross-section needed for withstanding shear stress acting (mm^2).

The area resisting the shear is the area of the secant of the pin as shown in Fig. 3.

$$A_{secant} = 1/2 \times r^2 \times (\pi/180 \times \theta - \sin \theta)$$

$$A_{secant} = 1/2 \times (12.5)^2 \times (\pi/180 \times 106.2 - \sin(106.2))$$

$$A_{secant} = 69.889 \text{ mm}^2 > [A_s] \quad [\text{Safe}]$$

Where A_{secant} is area of circular secant (mm^2), r is radius of circular section (mm), θ is central angle (degree).

2) Torsional Stress

The pressure of projectile driving band on edges of lands produces moment.

$$M = n_g \times N \times (x/2) \times \cos \alpha$$

$$N = 0.57 \times (\tan \alpha / n_g) \times F$$

Where n_g is number of grooves, N is normal pressure force (N), x is offset from center of barrel bore till shear surface (mm), α is twist angle of rifling (degree).

$$N_{7.62} = 0.57 \times (\tan(6) / 4) \times 13681 = 204.89 \text{ N}$$

$$M_{7.62} = 4 \times 204.89 \times (25 \times 10^{-3} / 2) \times \cos(6)$$

$$= 10.2 \text{ N.m}$$

$$I = (1/12) \times M \times L^2$$

Where I is moment of inertia of pin ($\text{Kg} \cdot \text{m}$), M is mass of rod (Kg), L is length of rod (m).

$$I = (1/12) \times (6.5 \times 10^{-3}) \times (30 \times 10^{-3})^2$$

$$I = 487.9 \times 10^{-9} \text{ Kg} \cdot \text{m}^2$$

$$\sigma = M \times x / I = (10.2 \times 12.5 \times 10^{-3}) / (487.9 \times 10^{-9})$$

$$\sigma = 261538.46 \text{ Pa} = 261.538 \text{ Mpa} < [\sigma_E] \quad [\text{Safe}]$$

On making sure that the designed pin can withstand the stresses provoked due to firing, a design for locking mechanism must be done to ensure that pin will not be removed unintentionally.

The locking mechanism is designed such that unlocking is done only by rotating the hand on other side anti-clockwise then push the locking pin forward then rotating it for unlocking.

B. The Barrel

The barrel used is having the standard total length of 415 mm AK-47 barrel and the same external shape but with a different barrel bore 7.62*39mm barrel is of 376 mm rifling length and chamber is fitted for bottleneck cartridge case. But 5.56*45mm NATO barrel is of 367 mm rifling length and the chamber is fitted for a straight cartridge case.

The barrel will have a hole of a diameter of 6 mm drilled in it at the rear section which is the connection between the barrel and weapon receiver.

As shown in Fig. 4, the change in cartridge length cause the decrease in rifling length of 5.56*45mm NATO barrel.

The gas unit remains in position for two barrels with the same characteristics, although in the case of 5.56*45mm NATO it gives higher pressure inside the chamber and higher velocity for piston and recoiling parts motion, this services in increasing the rate of fire of weapon that increase the power of fire of weapon system [4].

C. The Breech Block [5]

Although changing this part will require disassembly of the weapon system but it was difficult to get a method to keep the breech block to serve for both calibers 7.62*39 mm and 5.56*45mm NATO. The breech block used for 5.56*45mm NATO ammunition has a smaller face area for clamping the

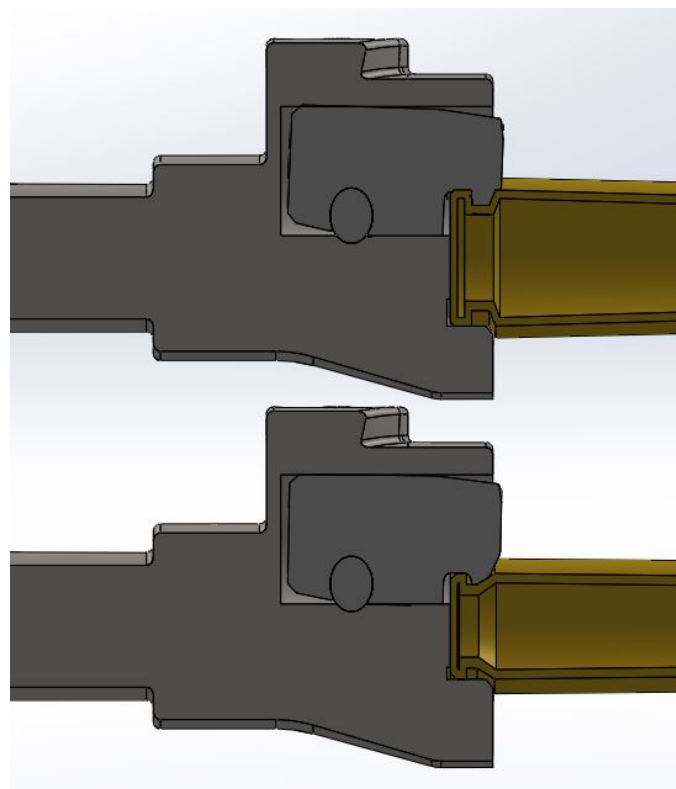


Figure 5: Upper: 7.62*39 mm cartridge, breech block and extractor
Lower: 5.56*45mm NATO cartridge, breech block and extractor

5.56*45mm NATO rim correctly and smaller extractor dimensions as shown in Fig. 5.

D. Magazine

The magazine used for 5.56*45 mm NATO is an AR-15 style rifle magazine with an adaptor attached to its mouth to be used in AK-47, as there is a difference in width of both magazines, the magazine catch of 5.56*45mm NATO is not compatible with that of an AK-47 rifle.

So, the designed adaptor has a compatible forward magazine catch with rifle trunnion and a rear magazine step for magazine catch. The adaptor uses the already AR-15 rifle

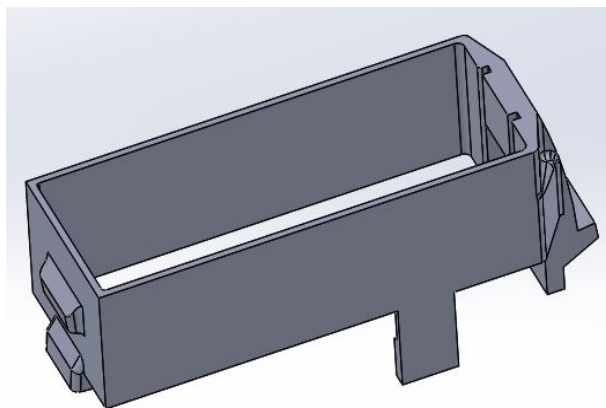


Figure 6: AR-15 style rifle magazine adaptor

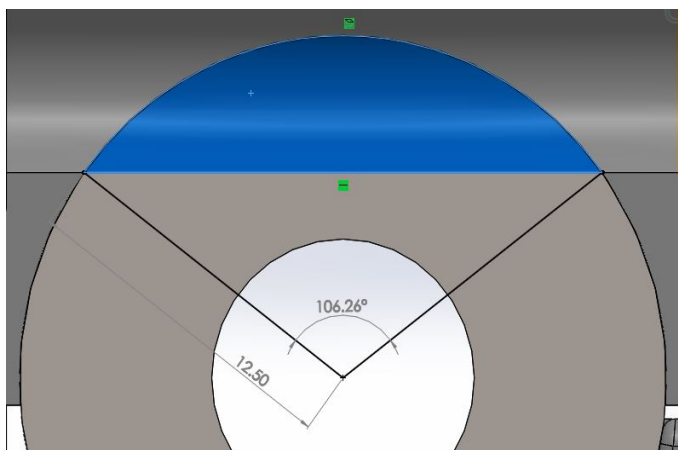


Figure 3: Area of secant area of pin where force affect

style magazine catch position for its positioning on the AR-15 magazine as shown in Fig. 6 and Fig. 7.

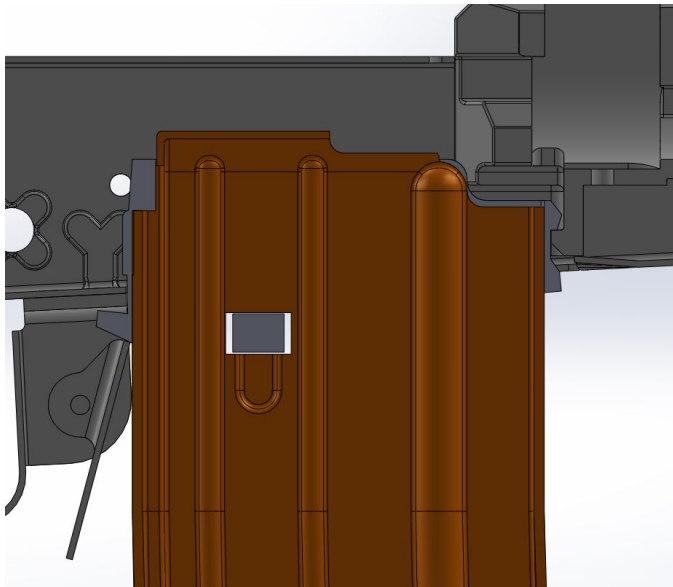


Figure 7: AR-15 style rifle magazine with adaptor inserted in AK-47 automatic rifle

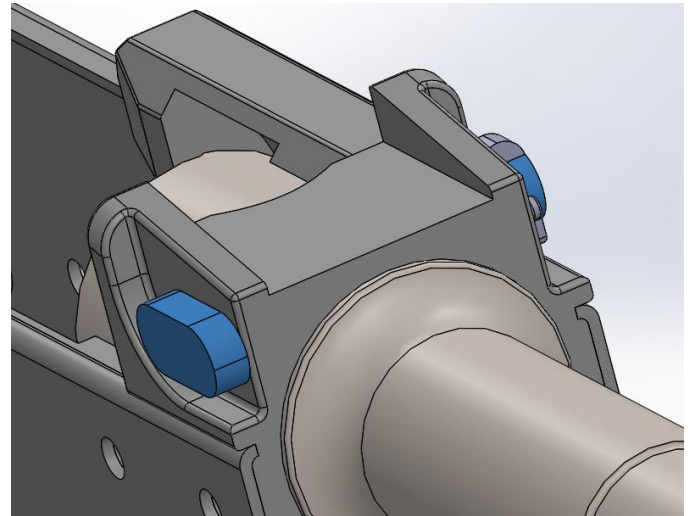


Figure 8: Locking pin with locking mechanism
Barrel locked

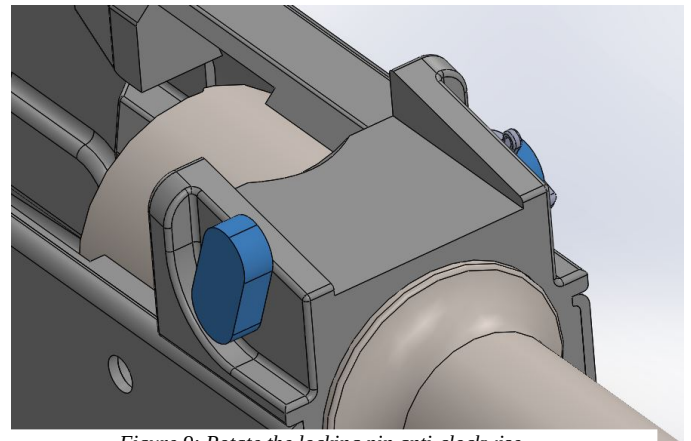


Figure 9: Rotate the locking pin anti-clockwise

III. ASSEMBLY AND DISASSEMBLY

To convert the fired cartridge of the AK-47 automatic rifle from 7.62*39 mm to 5.56*45 mm NATO, the following procedures are done:

- 1- Remove the magazine.
- 2- Make sure that the rifle is free of any cartridges.
- 3- Change the barrel:
 - a- Unlock the locking pin, As shown in Fig. 8, Fig. 9, Fig.10, Fig.11 and Fig. 12.
 - b- Remove the locking pin, as shown in Fig. 13.
 - c- Remove the barrel, as shown in Fig. 14.
 - d- Insert the required barrel.
 - e- Insert the locking pin.
 - f- Lock the locking pin.
- 4- Disassembly the weapon.
- 5- Change the breech block into required one.
- 6- Re-assembly the weapon.
- 7- Insert the required magazine.

In case of changing the barrel only, just procedures from 1 to 3 are done.

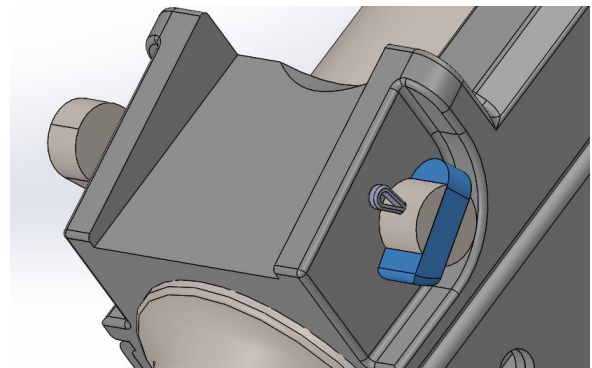


Figure 10: Rotating pin is released

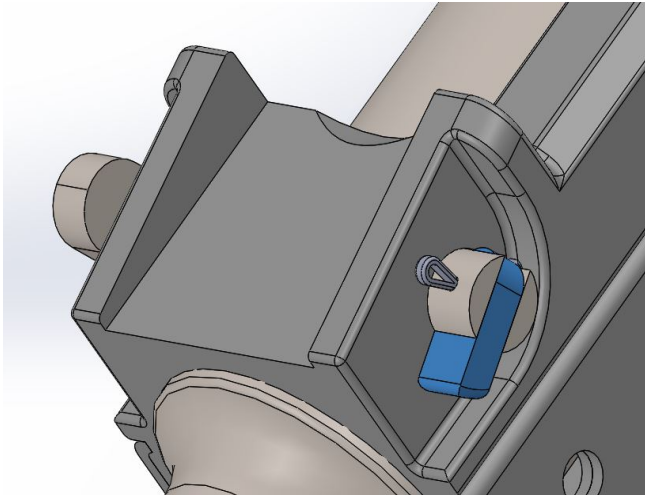


Figure 11: Push the rotating pin forward

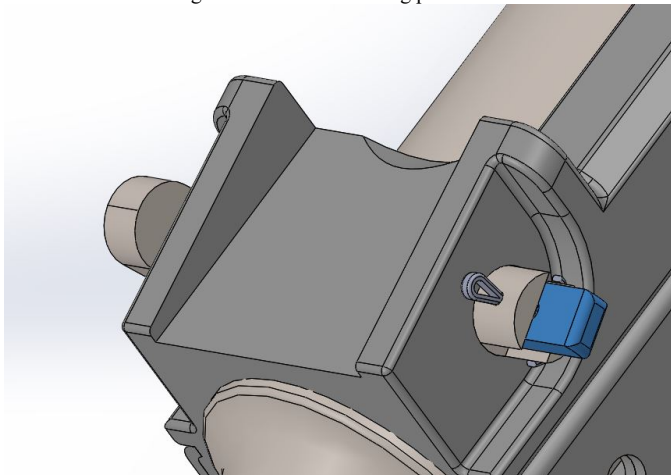


Figure 12: Rotate the rotating pin anti-clockwise
Barrel unlocked

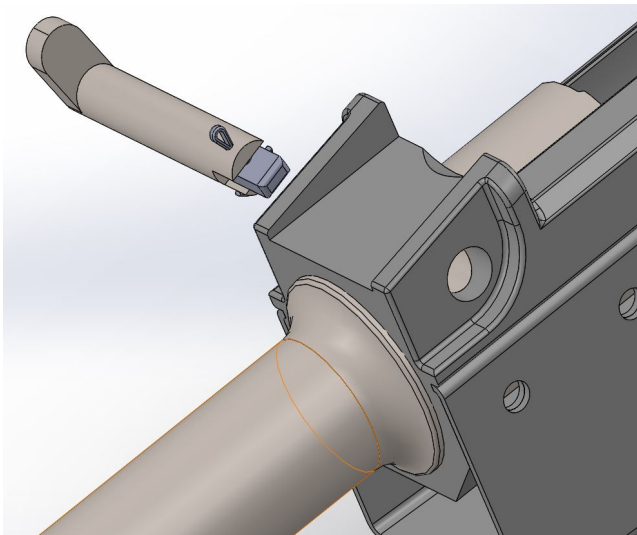


Figure 13: Remove the locking pin

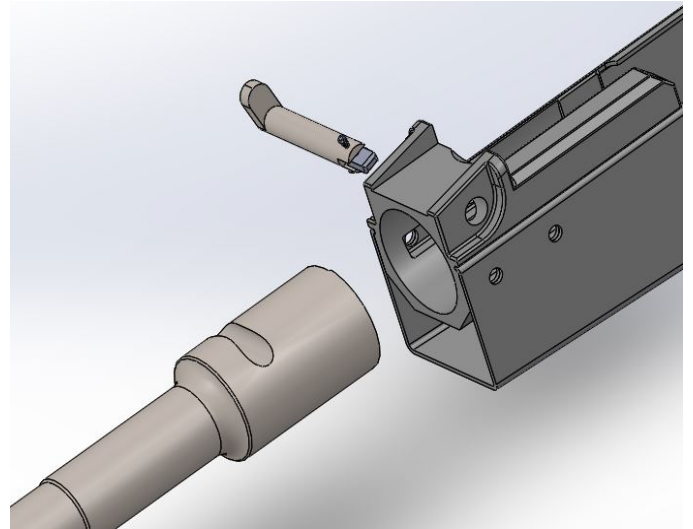


Figure 14: Remove the Barrel

Having a weapon that can fire the two calibers 7.62*39 mm and 5.56*45 mm NATO makes it capable to have diversity in armament and increases maneuverability and reliability of the weapon.

A. Advantages of firing 7.62*39 mm projectile:

- 1- Greater energy along trajectory
- 2- Greater penetration abilities on using piercing projectiles
- 3- Lower muzzle pressure, lower recoiling force and lower sound effect

B. Advantages of firing 5.56*45 mm NATO projectile:

- 1- Higher muzzle velocity
- 2- On hitting non crucial human parts, it causes a non-lethal effect, so the injured person needs to be evacuated so at least two persons will be out of action.
- 3- Lower weight of cartridge so higher ability of transporting more quantity on same transportation mean

Also, even the caliber of the weapon will not be changed, having an interchangeable barrel in combat action is beneficial in combat in to change the barrel in the following situations:

- 1- Overheating of barrel.
- 2- Barrel is hit by shrapnel.
- 3- Barrel having a bulge.
- 4- Rifling have torn out lands.
- 5- Barrel reach the end of its lifetime.

Even if the barrel is robust and with no malfunction, it can be used again if any damage occurs to weapon receiver.

IV. ADVANTAGES AND BENEFITS

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