

Review on Advance Towed Artillery Gun System

^[1] Omkar R. Girame, ^[2] Hemant V. Kadam, ^[3] Suvarna D. Khakal, ^[4] Nilesh D. Bagul
^[1] ^[2] ^[3] ^[4] Student, Rajgad Dyanpeeth Technical Campus, Shri Chhatrapati Shivajiraje College of Engineering,
Dhangawadi, Bhor, Pune, Maharashtra.

Abstract— A Nation cannot be economically strong without Strong Defence. So, the defence is main factor for developing any country. India is developing country and India has DRDO (Defence Research and Development Organization) and ARDE (Armament Research and Development Establishment) to take care of Researches in Defence sectors. Indian Defence Ministry allows privet manufacturer to contribute in the production of the defence product. DRDO has launched the Advance Artillery Gun in collaboration with the Manufacturer Partner TATA Group and Bharat Forge LTD. named Advance Towed Artillery Gun System (ATAGS). ATAGS has several advantages over the recent artillery gun. ATAGS is the 155*52 Caliber gun which has firing range 45 km. ATAGS has made the world record to fire the range up to 48.074 km. during Indirect Firing. Production of Gun will start by 2019 on large scale at TATA Group and Bharat Forge LTD.

Keywords: Artillery gun, ATAGS.

I. INTRODUCTION

Artillery is a class of large military weapons built to fire munitions far beyond French naval piece of the late 19th century the range and power of infantry's small arms. Early artillery development focused on the ability to breach fortifications, and led to heavy, fairly immobile siege engines. As technology improved, lighter, more mobile field artillery developed for battle field use. This development continues today; modern self-propelled artillery vehicles are highly mobile weapons of great versatility providing the largest share of an army's total firepower. In its earliest sense, the word artillery referred to any group of soldiers primarily armed with some form of manufactured weapon or armor. Since the introduction of gunpowder and cannon, the word "artillery" has largely meant cannon, and in contemporary usage, it usually refers to shell-firing guns, howitzers, mortars, rockets and guided missiles. The projectiles fired are typically either "shot" or "shell". Shell is a widely used generic term for a projectile, which is a component of munitions. By association, artillery may also refer to the arm of service that customarily operates such engines. In the 20th Century technology based target acquisition devices, such as radar, and systems, such as sound ranging and flashes spotting, emerged to acquire targets, primarily for artillery. These are usually operated by one or more of the artillery arms. The widespread adoption of indirect fire in the early 20th century introduced the need for specialist data for field artillery, notably survey and meteorological, in some armies provision of these are the responsibility of the artillery arm. Artillery originated for use against ground targets-against infantry, cavalry and other artillery.

1.1 Classification of Artillery

Artillery types can be categorized in several ways, for example by type or size of weapon or ordnance, by role or by organizational arrangements.

According to Types of ordnance

- Field Artillery
- Naval artillery
- Coastal artillery

Modern field artillery can also be split into two other subcategories:

- Towed artillery gun
- self propelled artillery gun

As the name suggests, towed artillery has a prime mover, usually an artillery tractor or truck, to move the piece, crew, and ammunition around. Towed artillery is in some cases equipped with an APU for small displacements. Self propelled artillery is permanently mounted on a carriage or vehicle with room for the crew and ammunition and is thus capable of moving quickly from one firing position to another, both to support the fluid nature of modern combat and to avoid counter battery fire. It includes mortar carrier vehicles, many of which allow the mortar to be removed from the vehicle and be used dismounted, potentially in terrain in which the vehicle cannot navigate, or in order to avoid detection.

1.2 Howitzer

A howitzer is a type of artillery piece characterized by a relatively short barrel and the use of comparatively small propellant charges to propel projectiles over relatively high trajectories, with a steep angle of descent. Most common type of Howitzers are as follows:

- Towed howitzers

- Self-propelled howitzers
- Fixed Howitzer
- Self-propelled Howitzer
- Pack Howitzer.
- Mountain Howitzer
- Siege Howitzer
- Field Howitzer

III. ADVANCE TOWED ARTILLERY GUN SYSTEM (ATAGS)

The Advanced Towed Artillery Gun System (ATAGS) project was started in 2013 by DRDO to replace older guns in service in the Indian Army with a modern 155mm artillery gun. Armament Research and Development Establishment (ARDE) partnered with Kalyani Group, Tata Power and OFB for this purpose. The gun is expected to start user trials in 2017 and production is expected to start in 2019. It was first publicly showcased at 68th Republic Day parade on 26 January 2017.

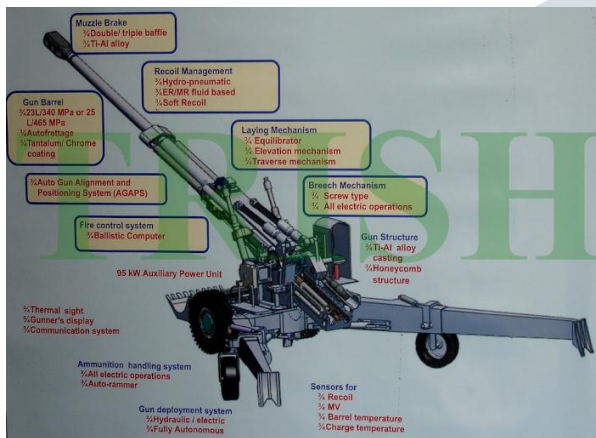


Figure: ATAGS Configuration

The production order could be a bonanza for India's private defense groups, as the country's army seeks to fill its requirement of over 1,500 towed guns, Sputnik News reported today. The ATAGS, India's first indigenous 155mm/52-caliber towed artillery gun, will be a joint project of two private-sector corporations.

2.1 ATAGS Construction

ATAGS is advance towed artillery which is the futuristic Artillery Weapon. Construction of ATAGS includes following components, which has main functions during firing the large projectiles.

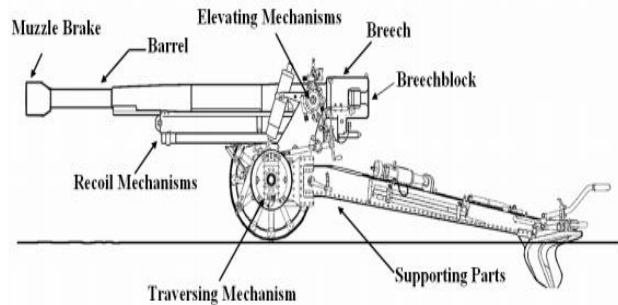


Figure: Artillery structure

2.1.1 Gun Barrel

A Gun Barrel is the main part of the artillery gun type ranged weapons such as small fire arms, artillery pieces and air guns. It is the straight shooting tube, usually made of rigid high straight metal, through which a contained rapid expansion of high pressure gases is introduced via propellant combustion or via mechanical compression behind a projectile in order to propel it out of the front end with high velocity. Gun barrel of the ATAGS are made by using the Autofrettage Manufacturing techniques. Autofrettage is metal fabrication technique in which high pressure vessel is subjected to enormous pressure, causing internal portion of the part to yield plastically, resulting in internal compressive residual stresses once the pressure is released. The goal of autofrettage is to increase the durability of the final product. Inducing residual compressive stresses into materials can also increase their resistance to stress corrosion cracking; that is, non-mechanically-assisted cracking that occurs when a material is placed in a corrosive environment in the presence of tensile stress. ATAGS gun barrel has Tantalum or Chrome coating, which provide several advantages to gun barrel.

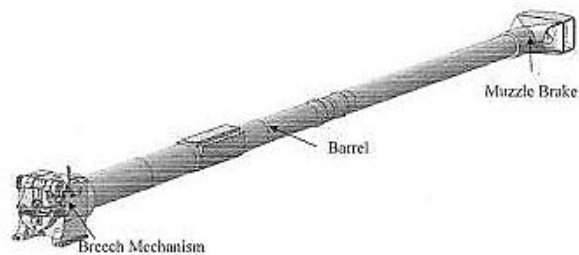


Figure: Gun Ordnance of 155mm – 52cal. Artillery Gun (Breech Block, Barrel, Muzzle Brake)

2.1.2 Breech Mechanism

Breech Mechanism in Artillery includes the Breech Blocks, Breech Loading mechanism and shell loading mechanism. A breech comprises a breech ring screwed to the barrel and

a breech block with mechanisms for closing the breech, providing obturation and a means of firing. Breech Loading designs the breech provides obturation and a 'tube' in which very small cartridge sometimes called a 'primer' is loaded into the lock attached to the outside the breech provides propellant ignition. Breech loading breeches always used a breech screw as their closing mechanism. Screw breeches, supported by a carrier, were closed by being swung in on a hinge and twisted to lock them in. Interrupted threads were used to minimize the amount of screwing. ATAGS uses the screw type breech mechanism for the firing the shell. And the shells loading operation of gun include the electrically operated rammer and the electrically operated Crain. It seen that all operation in the gun done automatically which results minimum no of crew.

2.1.3 Muzzle Brake

A muzzle brake is a device connected to the muzzle of a fire arm that redirects propellant gases to counter Recoil and unwanted rising of the barrel. The concept was first introduced for artillery and was a common feature on many Antitank Guns, especially those mounted on tanks, in order to reduce the area needed to take up the strokes of recoil and kickback. They have been used in various forms for rifles and pistols to help control recoil and the rising of the barrel that normally occurs after firing. Muzzle brake of the ATAGS manufacture using the Titanium and Aluminum alloy materials.

2.1.4 Recoil Management

Recoil is the backward movement of a gun when it is discharged. In technical terms, the recoil momentum acquired by the gun exactly balances the forward momentum of the projectile and exhaust gases, according to Newton's third law, known as conservation of momentum. In hand-held small arms, the recoil momentum is transferred to the ground through the body of the shooter; while in heavier guns such as mounted machine gun or Cannons, recoil momentum is transferred to the ground through the mount. In order to bring the rearward moving gun to a halt, the momentum acquired by the gun is dissipated by a forward acting counter-recoil force applied to the gun over a period of time after the projectile exits the muzzle. To apply this counter-recoiling force, modern mounted guns may employ recoil buffering comprising springs and hydraulic recoil mechanisms, similar to shock absorbing suspension on automobiles. ATAGS has Hydro-pneumatic Recoil cylinder for performing the recoil operation of the gun. The recuperator fills with compressed gases, and the nitrogen gas is usually used because of its inactivity. The recuperator of the independent type is separated from recoil brake completely. Furthermore, the

piston rods both directly connect with a back part. When the gun recoils, hydraulic fluid or oil will flow to the chamber of compressed gas. The fluid will then press on the gas to make the gas pressure rising, and the action will reverse during the recuperating time.

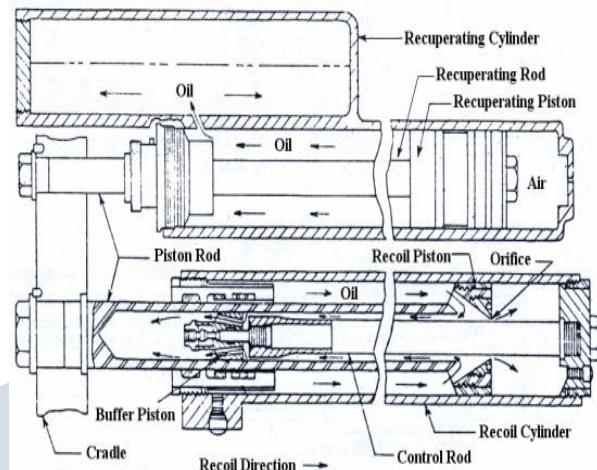


Figure: Hydro-pneumatic recoil system

On the other hand, the recuperator of the dependent type is often connected to the recoil brake, but the gas is separated from fluid by the floating piston. Besides, the recoil piston rod links a back part simply. On the way of throttling, the fluid from recoil cylinder would be pressed on recuperating cylinder.

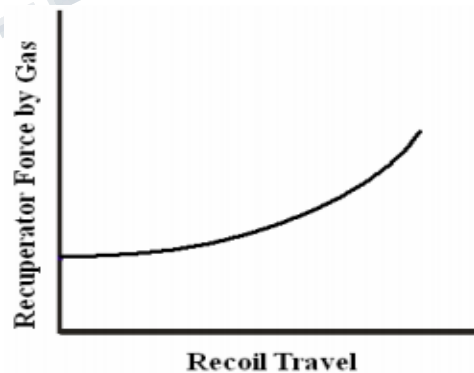


Figure: Curve of Recuperator force

The reliability of the hydro-pneumatic system is higher, the durability is better, the recoil distance is long, and the design is more flexible. However, the device needs specialized technology and the cost is expansive. In addition, the gas pressure will be easily changed by the atmosphere temperature, and affect the recoil velocity and recoil travel. So it needs some compensation. Moreover, the device is

hard to keep the high firing frequency, because of the heat generation.

2.1.5 Laying Mechanism

Gun laying is the process of aiming an artillery piece, such as a gun, howitzer or mortar, on land or at sea, against surface or air targets. It may be laying for direct fire, where the gun is aimed similarly to a rifle, or indirect fire, where firing data is calculated and applied to the sights. The term includes automated aiming using, for example, radar-derived target data and computer-controlled guns. Gun laying means moving the axis of the bore of the barrel in two planes, horizontal and vertical. A gun is "traversed" (rotated in a horizontal plane) to align it with the target, and "elevated" (moved in the vertical plane) to range it to the target.

2.1.6 Fire control system

A fire-control system is a number of components working together, usually a gun data computer, a director, and radar, which is designed to assist a weapon system in hitting its target. It performs the same task as a human gunner firing a weapon, but attempts to do so faster and more accurately. ATAGS use the Ballistic computer as fire control system for supporting the gun during fire. Above all are the main components of artillery which involve its own contribution during the firing condition.

2.2 Specifications of ATAGS

ATAGS	
Production specifications	
Designer	ARDE
Designed	2010-2014
Manufacturer	Tata Power SED Kalyani Group
No. Built	2 Prototype
Produced	2019
Gun Specifications	
Length of Barrel	52 Caliber 8060 mm
Crew	6-8
Caliber	155 mm
Breech	Screw type
Elevation	-3 to 70 degree
Traverse	+/-30
Rate of fire	
Burst	3 rounds in 13 seconds
Intense for 3 mines	15 rounds in 3 minutes
Sustained	60 rounds in 60 minutes
Maximum firing range	55 Km
Mobility	With towing vehicle :
	40kmph Self propelled: 12kmph

Table: ATAGS Specifications

2.3 ATAGS Achievements

In trial firing at the Pokhran Ranges in Rajasthan, the advanced towed artillery gun system (ATAGS) being indigenously developed for the Indian Army demonstrated its potential to be a world-beating system. The 155-millimetre, 52-calibre gun-howitzer fired three shells out to a world-record distance of 48.07 kilometers from the gun position. Earlier, the same gun had broken another record by firing "high explosive – boat tail" (HE – BT) ammunition to a range of 37.2 kilometers. Range, accuracy and consistency are the key attributes of an artillery gun. A longer range allows more area to be engaged from a "gun position", without having to redeploy (or shift) the guns. The secret of the ATAGS longer range is its larger chamber – 25 liters, compared to 23 liters in most 155-millimetre guns.

III. CONCLUSION

The gun is two ton lighter than guns in the same category and is designed to provide better accuracy and range and is capable of firing five successive rounds in short duration. (ATAGS) being indigenously developed for the Indian Army demonstrated its potential to be a world-beating system. The 155-millimetre, 52-calibre gun-howitzer fired three shells out to a world-record distance of 48.07 kilometers from the gun position. Due the above it concludes that ATAGS gun has several advantages with the recently used Dhanush Artillery Gun.

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