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Sighting Methods for the 40-mm Powder Gun

by Todd Brinkman

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14. ABSTRACT

The 40-mm powder gun has become a reliable and efficient research tool used by the US Army Combat Capabilities Development Command (CCDC) Army Research Laboratory (ARL) Weapons and Materials Research Directorate’s Explosive Effects Branch. This powder gun can shoot an 18-g spherical NATO Standardization Agreement (STANAG) fragment encased in a polycarbonate sabot and can use several different sighting options during its operation. This report provides a brief description of the sighting methods used in experimental programs based on the program requirements and gun to target accuracy.

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1. Introduction

The 40-mm powder gun has become a reliable and efficient research tool used by the US Army Combat Capabilities Development Command (CCDC) Army Research Laboratory (ARL) Weapons and Materials Research Directorate's Explosive Effects Branch. This device replicates the terminal effects of high-speed fragments from exploding munitions during battlefield engagements. An 18-g spherical STANAG (standardization agreement by which NATO countries use processes and procedures for common military equipment) fragment encased in a polycarbonate sabot is launched at speeds up to 8300 feet per second into various targets with pinpoint accuracy. The gun itself consists of four main parts: the I-beam stand, the main barrel, the wear section, and the breech plug. This report will only focus on the main barrel and the breech plug parts to describe four sighting methods.

2. Sighting Methods

The techniques outlined here will involve the muzzle end (fragment-exit end) and the breech plug (fragment-loading end) of the barrel assembly. Depending on the experiment being performed, weather conditions, target size, accuracy requirements, and so on, there are four ways to sight this device. Although not all may be adequate for a specific experiment, training, practice, and time will reveal to the operator which method is best to meet the experiment requirements. The following sighting methods have all been used successfully in prior experimental programs.

2.1 Method 1: Through-Barrel Sighting

The through-barrel method of sighting is nothing more than looking from the breech end to muzzle end, through the barrel, with the naked eye. While this option should not be relied on for any significant accuracy, it is more than adequate in sighting for velocity determination, for barrel warming, and as a launch package flight check. For this method, the operator may also choose to apply lengths of string, held with tape, vertically and horizontally across the center of the muzzle for a better sight picture (Fig. 1). Once the barrel is sighted, the tape and string are removed. When using this method in sunny conditions, the gunner may experience reflections in the bore resulting in a distorted view through the muzzle into the target.

Fig. 1 Sighting with string crosshairs

2.2 Method 2: Muzzle Laser

The muzzle laser method is performed using a brass adapter, approximately 8 inches long, that is placed into the muzzle end of the gun (Fig. 2). The face of the adapter is drilled and tapped to accept the threaded stem of an adjustable laser. **(CAUTION: PLEASE TAKE ALL NECESSARY SAFETY PRECAUTIONS DURING USE OF ANY CLASS II LASER).** The laser beam has an effective range of 20 ft, from the muzzle end of the gun to the target. A 20-ft standoff distance is a common distance for all 40-mm experiments. The caveat to this method is that a checkout shot must be executed, before the program shots, to verify the barrel to laser accuracy

The laser itself has an adjustable beam that can be moved vertically (elevation) and horizontally (azimuth). Because the barrel is set on multiple rollers fixed to a large I-beam, the device itself does not have the capability to be moved or pointed at the target. Thus, the target must be placed and adjusted to the laser beam (firing path).

To find this path, the operator must install the laser into the muzzle and mark that spot on a plate or sacrificial target. Once the laser is removed, the operator can then fire the gun as normal and locate where the fragment impacted the target. If the fragment impacted off the previous mark on the target, the operator will reinstall the laser and make the necessary adjustments to bring the laser beam to the center point of the fragment impact. While this option is more time consuming, prior programs have used this alignment shot as a verification for velocity recordings. This option is the most reliable when it comes to the pinpoint accuracy required on small targets.

Fig. 2 Laser with brass adapter

2.3 Method 3: Breech Plug

The breech plug option uses a spent (previously fired) .300 Winchester Magnum case inserted into the breech plug of the gun (Fig. 3). The primer is removed from the spent case to give the operator the smallest sight picture (peep hole) as possible. Once inserted, the operator should have a clear, unobstructed view through the case to the target. The case must be removed before firing the device. The breech plug must be fully installed for this sighting method to work properly. When using this method in sunny conditions, the gunner may experience reflections in the bore resulting in a distorted view through the muzzle into the target. This method should be used where pinpoint accuracy is not required, such as on larger targets. However, it is a more accurate method than sighting through the open bore (Method 1).

Fig. 3 Winchester Magnum case inserted into the breech plug

2.4 Method 4: Breech Plug with Laser

This final method, the breech plug with laser, is a combination of Methods 2 and 3. It employs the use of a spent .300 Winchester Magnum case with a built-in laser. As in Method 3, the case is installed into the breech plug and the beam is illuminated down the length of the bore, exiting the muzzle to the target surface (Fig. 4). The unit is preset at the factory and is calibrated right out of the box. The breech plug must be fully installed for this sighting method to work properly. Not fully installing the breech plug can result in misalignment of the laser down the bore of the barrel. As with the other options, the laser must be removed from the barrel prior to firing. This method is slightly more accurate than Method 3 and can be used in sunny conditions.

Fig. 4 300 Winchester with laser

3. Conclusion

The operator has the option of using any of the four sighting techniques depending on experiment requirements and atmospheric conditions. Method 1 (through-barrel sighting) is the simplest of all the methods and should be used where accuracy is not an issue or where large targets are required. It is often used for velocity determination, barrel warming, and as a launch package flight check. Method 2 (muzzle laser) is a more complex method and is typically used for high-accuracy shots. It can be successfully used in all weather conditions and target sizes. Method 3 (breech plug) can be used on slightly larger targets where accuracy is not much of an issue. However, sunny conditions can affect the operator's sight picture when using this method. Method 4 (breech plug with laser) is a combination of Methods 2 and 3 and is typically used on larger targets that do not require pinpoint accuracy and can be used in sunny conditions. These sighting procedures will benefit the weapons operator from either simply sighting down the tube for acquiring a total target picture, or more pinpoint accuracy by the laser.

List of Symbols, Abbreviations, and Acronyms

ARL	Army Research Laboratory
CCDC	US Army Combat Capabilities Development Command
EEB	Explosive Effects Branch
NATO	North Atlantic Treaty Organization
STANAG	STANdardization AGreement

1 (PDF)	DEFENSE TECHNICAL INFORMATION CTR DTIC OCA
1 (PDF)	CCDC ARL FCDD RLD DCI TECH LIB
25 (PDF)	CCDC ARL FCDD RLW LC J SADLER FCDD RLW P R FRANCART FCDD RLW PA S BILYK FCDD RLW PB M KLEINBERGER FCDD RLW PD B KRZEWINSKI FCDD RLW PE P SWOBODA FCDD RLW PG D ABELL J ANDERSON T BRINKMAN J K BOYD C CUMMINS P DUVALL E FIORAVANTE D FOX N GNIAZDOWSKI B HOMAN S HUG S KOUNDINYAN S KUKUCK T PAYNE C PECORA J PRITCHETT B SHOWALTER J STEWART S TROMBETTA