small arms survey

Research Notes

WEAPONS & MARKETS

NUMBER 51 • APRIL 2015

Guided Mortar Systems

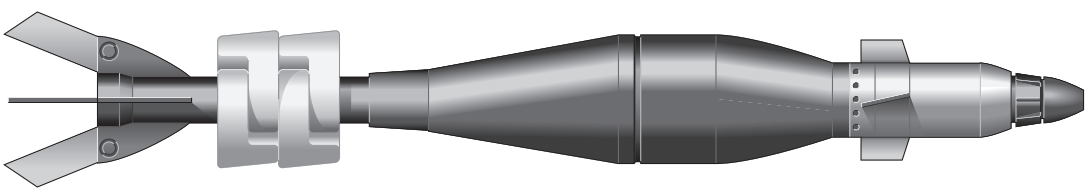
Guided mortar systems are guided weapons intended to provide increased firing accuracy and reduced ammunition consumption over their conventional counterparts. Mortars typically fire projectiles intended for use against personnel, light armoured vehicles, and structures. They are normally smooth-bore, muzzle-loading, indirect-fire support weapons that allow the operators to engage targets that may not be within their line of sight. Conventional mortars do not have recoil mechanisms, with the main recoil force being transmitted directly to the ground via the baseplate. Additionally, most mortars are restricted in elevation, only capable of firing at high-angle trajectories (above 45°), meaning that they cannot be used in the direct-fire support role (Ryan, 1982).[1] Mortars are limited in range and accuracy when compared to many other artillery systems.

Guided mortar systems allow for precision targeting and increased first-round hit probability, and greatly reduce the potential for collateral damage. The ATK XM395 120 mm Precision Mortar, currently in service with the US Army under the Accelerated Precision Mortar Initiative, and the General Dynamics Ordnance and Tactical Systems 81 mm and 120 mm Roll Controlled Guided Mortar (RCGM)[2] projectiles all have a circular error probable (CEP) of less than ten metres, making them more than seven times as accurate as unguided mortar projectiles in the US Army inventory (Calloway, 2011; Habash, 2012). Conventional mortar systems typically require two or more rounds to be fired in order to stabilize the firing platform and make corrections for weather effects, if the latter have not been calculated in the firing solution, before being capable of accurately delivering fire on target. Some guided mortar systems minimize or obviate this requirement and allow for much lower ammunition consumption. An especially desirable advantage is that this allows for greater mobility, one of the characteristics that distinguish mortars from other types of artillery. Finally, the increased accuracy of guided mortar systems has increased the utility of the mortar as an anti-tank weapon, allowing for the more accurate engagement of moving targets. The advantages of guided mortar systems have made them increasingly popular weapons and they are now in service with several militaries around the world.[3]

Guided mortar systems first entered development more than thirty years ago. Early attempts to develop guided mortar systems were limited by the comparatively small size of mortar projectiles and fuzes compared to larger guided missiles and guided artillery projectiles. Advances in microelectronics have allowed for the development of effective guidance packages and fuze assemblies within the size constraints of mortar projectiles (Weber, 2014). Guided mortar projectiles are considered precision guided munitions (PGMs), and are often part of a broader battlefield command network that may include target-designation systems, fire-control computers, and communications devices.

In most cases guided mortar projectiles have been developed so that no modifications need to be made to the mortar tube itself, allowing new munitions to be used with in-service weapons. Guided mortar projectiles are often compatible with all smooth-bore mortars of the same calibre. Both smooth-bore and rifled guided mortar projectiles have been developed.

Guided mortar projectiles differ from unguided mortar projectiles by their inclusion of a guidance and navigation unit (GNU)[4] and a method of adjusting the munitions' trajectory in flight. Some guided mortar projectiles are purpose-built, while others use existing (typically in-service) mortar projectile bodies modified by the addition of a guidance assembly and a tail assembly. This 'bolt-on' approach is similar to the conversion of a general-purpose aircraft bomb into a PGM by the addition of a guidance kit. In-flight trajectory adjustments



General Dynamics Ordnance and Tactical Systems 120 mm Roll Controlled Guided Mortar (RCGM) projectile, an example of a 'bolt on'-type conversion kit that allows for the use of in-service components such as the projectile body (warhead), ignition cartridge, propellant, and fuze.

can be accomplished by a variety of methods, including fins, motor-control options, and special pyrotechnic rotation charges (Weber, 2014). Guided mortar projectiles may also offer multiple fuzing options to the firer, including impact (point-detonating), time-delay, and proximity modes. Many guided mortar projectiles are fitted with a self-destruct mechanism to minimize the risk of collateral damage from munitions that fail to function.

Two common methods of guidance are used in conjunction with these systems: semi-active laser (SAL) guidance and satellite (typically GPS) guidance. The use of laser-designation technology provides a high level of accuracy, but requires a clear line-of-sight from the laser target designator to the target. Satellite guidance offers slightly reduced accuracy, but removes the need for an observer to ensure that the munition remains on target. While laser guidance remains the global standard for PGMs, the use of satellite guidance, sometimes combined with other guidance methods, is becoming increasingly commonplace (Weber, 2014). Other forms of guidance are used by some guided mortar systems, including millimetre-wave radar and infrared imaging.

While most modern guided mortar projectiles are of the high-explosive or high-explosive fragmentation type, optimized for use against personnel, light armoured vehicles, and structures, early guided mortar projectiles tended to be of the high-explosive anti-tank type. Examples include the 81 mm British Aerospace Defence Merlin—one of the earliest guided mortar projectiles developed—and the 120 mm Bofors Defence AB STRIX (Lewin, 2006). Both are true 'fire-and-forget' munitions.

Most guided mortar projectiles have been developed in the 81 mm and 120 mm NATO calibres, and their 82 mm and 120 mm Eastern Bloc equivalents; however, there have been some exceptions. The Soviet Union, for example, developed the 240 mm Smelchak ('Daredevil') and Smelchak-M projectiles for the 2S4 Tyulpan self-propelled heavy mortar (Grau, 2005).

Guided mortar systems are in limited service with several states, including the Russian Federation, Sweden, Switzerland, the United Kingdom, and the United States. Such systems have also been developed and offered for sale by manufacturers from other countries, including China, Germany, and Israel (Weber, 2014). To date, guided mortar systems have not been documented in the hands of non-state armed groups; however, their increasing prevalence on the battlefield may see this situation change in the future (Berman, Gobinet, and Leff, 2011). Despite this risk, guided mortar systems require a certain level of training and technical capability to be properly employed, and are most effective when supported by a wider battlefield command network. ■

Notes

1 Not to be confused with direct aiming at visible targets via an optical sight, which is one of the two conventional options for aiming mortars, the other being forward observer(s) and a fire controller.

2 Also referred to in the manufacturer's literature as the 'Roll-Controlled Guided Mortar' and the 'Roll Control Guided Mortar'.

3 See Calloway (2011), Dutoit and Zahnd (1997), Grau (2005), and Lewin (2006).

4 Sometimes referred to as a 'computer control group' (CCG) or a 'guidance, navigation, and control unit' (GNCU).

References

Berman, Eric G., Pierre Gobinet, and Jonah Leff. 2011. 'Mortars.' Research Note No. 2. Geneva: Small Arms Survey.

Calloway, Audra. 2011. 'Picatinny Fields First Precision-guided Mortars to Troops in Afghanistan.' US Army Press Release. 29 March. <http://www.army.mil/article/53988/>

Dutoit, Jean-Claude and Maurice Zahnd. 1997. 'Intelligente Munition für die 12-cm-Festungsminenwerfer.' *Allgemeine Schweizerische Militärzeitschrift*, No. 11.

Grau, Lester W. 2005. 'The High-precision Tulip: Development and Combat Employment of the Soviet Laser-guided Mortar Round.' *Journal of Slavic Military Studies*, Vol. 18, No. 4.

Habash, Yousef. 2012. 'Roll Control Guided Mortar (RCGM).' Presentation at NDIA Joint Armaments Conference. Seattle, 14–17 May.

Lewin, Joakim. 2006. 'STRIX.' PowerPoint presentation.

Ryan, J. W. 1982. *Guns, Mortars & Rockets*. Brassey's Battlefield Weapons Systems & Technology Series, Vol. 2. Oxford: Brassey's.

Weber, Michael E. 2014. *Guided Mortar Systems*. Unpublished Armament Research Services (ARES) confidential background paper.

For more information on light weapons, please visit <http://www.smallarmssurvey.org/?light-weapons.html>

About the Small Arms Survey

The Small Arms Survey is a global centre of excellence whose mandate is to generate impartial, evidence-based, and policy-relevant knowledge on all aspects of small arms and armed violence. It is the principal international source of expertise, information, and analysis on small arms and armed violence issues, and acts as a resource for governments, policy-makers, researchers, and civil society. It is located in Geneva, Switzerland, at the Graduate Institute of International and Development Studies.

The Survey has an international staff with expertise in security studies, political science, law, economics, development studies, sociology, and criminology, and collaborates with a network of researchers, partner institutions, non-governmental organizations, and governments in more than 50 countries.

Publication date: April 2015

Credits

Author: N. R. Jenzen-Jones

Contributors: Michael Horn, John Ismay, Graeme Rice, Michael Smallwood, and Michael E. Weber

Copy-editing: Alex Potter (alex.potter@mweb.co.za)

Proofreading: Donald Strachan

Design and layout: Richard Jones (rick@studioexile.com)

Contact details

Small Arms Survey
Maison de la Paix
Chemin Eugène-Rigot 2E
CP 136 – 1211 Geneva
Switzerland

t +41 22 908 5777
f +41 22 732 2738
e info@smallarmssurvey.org