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Islamic State Craft-produced Light Recoilless Guns: Conventional & Chemical Variants

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- AVOID** the area
- RECORD** all relevant information
- MARK** the area to warn others
- SEEK** assistance from the relevant authorities

Craft-produced Arms & Munitions Warning

Craft-produced arms and munitions can vary significantly in build quality, durability, and safety. The potential risks these items may pose to the user are often difficult to assess without specific knowledge of the production process. Craft-produced arms and munitions may also function in unexpected ways, including in a fashion distinct from visually similar mass-produced weapons. As such, particular care should be taken when accessing such items.

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Chemical weapons and toxic substances are extremely dangerous, even in small quantities. Exposure, inhalation, or contact can result in serious injury, long-term health effects, or death. You should never approach, handle, transport, or attempt to neutralise chemical agents unless you are specifically trained to do so.

Disclaimer

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Cover image: Drew Prater.

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Abbreviations & Acronyms

AN-AI	Ammonium nitrate and aluminium (explosive)
CW	Chemical weapons
CWC	Chemical Weapons Convention
EOD	Explosive ordnance disposal
HE	High explosive
HEAT	High explosive anti-tank
IED	Improvised explosive device
IRAM	Improvised rocket-assisted munition
IS	Islamic State
OPCW	Organisation for the Prohibition of Chemical Weapons
PIBD	Point-initiating, base-detonating
PETN	Pentaerythritol tetranitrate
PG-9 LR	'PG-9 Long Range'
PG-9 SR	'PG-9 Short Range'
RPG	<i>Ruchnoy Protivotankovyy Granatomyot</i> (‘Handheld anti-tank grenade launcher’) [Russian]
SPG	<i>Stankovyy Protivotankovyy Granatomyot</i> (‘heavy anti-tank grenade launcher’) [Russian]
SVBIED	Suicide vehicle-borne improvised explosive device
UAV	Unmanned aerial vehicles
VBIED	Vehicle-borne improvised explosive device

Introduction

The militant organisation known as the Islamic State (IS)—also referred to historically as the Islamic State of Iraq and Syria (ISIS) or the Islamic State of Iraq and the Levant (ISIL)—has been noted for its ability to produce and procure weaponry in the absence of resources and state-backing. One particularly important aspect of IS weapon procurement was the group’s ability to develop and produce semi-standardised arms and munitions through the modification of conventional weapons and craft production. One of the primary applications for craft-production techniques was to allow the group to maintain sufficient stocks of ammunition in the absence of purpose-built munitions. Whilst, broadly speaking, the arms and munitions produced by IS are not of factory-made quality, they nonetheless proved essential to the group’s territorial expansion during the mid-2010s. In addition to its arsenal of craft-produced conventional munitions—which included a range of weapons from improvised explosive devices (IEDs) to hand grenades to mortar projectiles—IS also manufactured chemical munitions. These chemical munitions took a variety of forms as well, from simple glass bottles filled with chemical agents to craft-produced mortar projectiles and modified conventional artillery gun projectiles.¹ In sum, these activities represent a comprehensive arms design, development, and production programme that offered the extremist group a relatively sophisticated arsenal of craft-produced arms and munitions. Supported by expertise, materials, and facilities gained from the capture of major cities such as Mosul in Iraq, this programme assisted IS in sustaining its combat operations for years.

This report examines one of the important varieties of craft-produced weapon produced by IS: shoulder-fired light recoilless guns and their munitions. Light recoilless guns made by the Islamic State first came to public attention in 2017, when IS-affiliated social media accounts posted a graphic depicting four shoulder-fired weapons which the organisation claimed to have produced (*see Figure 1.1*). The distribution and use of these weapons was later confirmed by explosive ordnance disposal (EOD) teams in Iraq and Syria. The four weapons, as shown in *Figure 1.2*, share common expelling/propelling charge, countermass assembly, and fin assembly designs, and can be considered variants of the same general (craft-produced) model of light recoilless gun. The first of the four variants advertised by IS is herein designated the Type 1, and fires a munition which uses a PG-7-type HEAT warhead. Type 2 and Type 3 recoilless guns both fire munitions which use PG-9-type HEAT warheads, offering a ‘short range’ and ‘long range’ capability, respectively. The Type 4 has been described in IS propaganda² as firing a thermobaric warhead, but in fact contains a simple high explosive (HE) fill of ammonium nitrate and aluminium (AN-Al). Descriptions of the four Types are provided below, presenting everything known thus far about these craft-produced light recoilless guns. This report also introduces the likely existence of a Type 5 variant—one which fired a munition with a chemical payload of sulphur mustard. An EOD team that included two of the authors located numerous examples of rocket-assisted projectiles with a chemical payload alongside other IS-made munitions, and in one instance found a likely chemical munition loaded into a metal tube. All five Types are depicted with summary technical data in *Figure 6*. The presence of a direct-fire, man-portable weapon firing a chemical munition formerly held in the IS arsenal is significant and may have impacts for threat assessment and force protection practitioners, amongst others. The report presents the following key findings:

- At the height of its territorial control, the Islamic State possessed a fairly sophisticated arsenal of craft-produced and improvised weaponry, often manufactured using tools, materials, and expertise captured from the areas it occupied;
- Amongst these craft-produced arms were shoulder-fired light recoilless guns, introduced by the organisation in 2017. In line with previous public and confidential reports on the topic, four Types

1 OPCW Technical Secretariat, 2024, § 6.

2 A claim repeated by several Western observers.

of conventional light recoilless guns—each with its own associated munition (projectile)—have been conclusively identified herein;

- The four Types of recoilless guns share several key features, which include the gripstock assembly, expelling/propelling charge, countermass, projectile fin assembly, and barrel with endcaps;
- Munitions resembling the projectiles used in the craft-produced recoilless guns but filled with chemical (sulphur mustard) payloads were identified by an explosive ordnance disposal (EOD) team in 2017. Based on their physical characteristics, these munitions have been identified as a fifth Type of IS recoilless gun ammunition; and
- The existence of a ‘Type 5’ recoilless gun, whilst unconfirmed, is implied by the existence of the Type 5 projectile, the fact that one such projectile was found inside of a tube, and the proximity of that tube to an expelling/propelling charge that strongly resembles those used in IS craft-produced conventional recoilless guns.

قاذف الصواريخ محلي الصنع

تستخدم قذائف هذه الصواريخ في معالجة وتدمير الاليات غير المدرعة، والذخري المزودة بالدروع التقليدية، كعربات الـ BMP، والممرات، وعربات الكوجار، والكوبرا، وغيرها، والذخيات ذات التدرج الخفيف، كالذخيات الروسية والأمريكية قديمة الطراز، وللحشوات الدافعة من نوعي PG-9 و PG-7V. قدرة اختراق للدروع ليكثر من 300 ملم.

نصائح للإمارة الصحيحة بقاذف الصواريخ:

- اختر النوع المناسب من الحشوات المتفجرة لمعالجة كل نوع من الأهداف.
- اطلق على المدف عندما يكون ضمن المدف المجدي حصرا.
- ارفع فوهة القاذف فوق أي مسند (جدار أو ساتر) بمقدار 20 سم على الأقل، لمنع احتكاك لوجة الصاروخ بالمسند أثناء انطلاقه.
- يفضل استخدام وققيات للذخين لحماية السمع من أصوات الإطلاق.
- يمكنك الإمارة من داخل البرنية، ومن المواقع المحصورة الضيقة، دون خوف من تأثير لهب الإطلاق للصواريخ.

قاذف للصواريخ فردي الاستعمال محمول على الكتف متعدد المهام يستخدم لمرة واحدة

إنتاج القاذف:
هيئة التصنيع والتطوير في الدولة الإسلامية.

الدخول في الخدمة:
1438 هـ.

قاذف صواريخ PG-9 بعيدة المدى
حشوة مضادة للدروع PG-9 بمحرك دفع إضافي
المدف المجدي: 700 م
طول القاذف: 113 سم
الوزن: 12.5 كغ

قاذف صواريخ PG-9 قصيرة المدى
حشوة مضادة للدروع PG-9
المدف المجدي: 300 م
طول القاذف: 90 سم
الوزن: 8.25 كغ

قاذف صواريخ PG-7V
حشوة مضادة للدروع PG-7V
المدف المجدي: 300 م
طول القاذف: 103 سم
الوزن: 10.75 كغ

قاذف الصواريخ الفراغية
قذيفة متفجرة ذات تأثير فراغي Thermobaric
المدف المجدي: 250 م
طول القاذف: 90 سم
الوزن: 10.5 كغ

الصاروخ مزود بمحرك دفع إضافي، الزينة المدف وتحقير إصابة أفضل للأهداف في المناطق المفتوحة خاصة

يتميز بخفة وزنه، وصغر حجمه، ما يجعل حمله أثناء التنقل والدراسة، واستخدامه داخل الأماكن الضيقة، وهو مناسب جدا للحروب المدن.

يقوم بنفس وظيفة القاذف RPG مع الحشوات الحرارية التقليدية، ويتميز عنه بإمكانية استخدامه في الأماكن المحصورة، كما في الإمارة من داخل البرنية.

يستخدم لتدمير تحصينات العدو واستهداف جنوده المتحصنين بالسواتر، ودخل النفق والخنادق. كما يمكن استخدامه في استهداف التليات والذخيات.

إنفوغرافيك النبا
شعبان 1438 هـ

Figure 1.1 An IS propaganda graphic depicting four models of craft-produced shoulder-fired light recoilless guns, posted by Islamic State-affiliated social media in 2017 (source: IS media via ARES CONMAT Database).



Figure 1.2 *The four previously documented Types of IS craft-produced recoilless light guns. From top to bottom: Type 2; Type 3; Type 4; and Type 1 (source: Drew Prater).*

Islamic State Arms Production

IS and its predecessors have been actively developing and maintaining arms and munitions production capabilities for approximately two decades in the Middle East. The organisation has demonstrated a remarkable capacity for innovation, inventing or further developing a variety of improvised, modified, and craft-produced arms and munitions. The use of craft-produced weapons almost invariably arises out of necessity.³ As a non-state actor with no affiliation to state armed forces,⁴ IS faced challenges in procuring necessary arms and munitions. Despite seizing significant quantities of military equipment in locations including Mosul and Tikrit in Iraq,⁵ as well as Ayyash⁶ and Raqqa⁷ in Syria,⁸ IS struggled to supply its forces

3 Hays & Jenzen-Jones, 2018, p. 40.

4 Indeed, IS proved a 'common enemy' for most states at its height.

5 Amnesty International, 2015, pp. 11–15.

6 ARES, 2024.

7 Speckhard & Yayla, 2016, p. 242.

8 Indeed, capture of both Iraqi and Syrian state military weaponry was one major source of IS weapon stocks. A Conflict Armament Research report notes that "...at the very least, 12 per cent of the weapons recovered from IS forces originate from Iraqi national stockpiles" and that "battlefield capture from Syrian forces is a significant source of IS forces' weapons and ammunition" (Conflict Armament Research, 2017, pp. 32–34).

with sufficient conventional weapons during its expansive combat operations. As early as 2014, the group had already established small factories where craft-produced munitions were made, relying on technology, facilities, and tools captured in their campaigns.⁹ Commonly produced munitions included 107 mm and 122 mm rockets, as well as 82 mm and 120 mm mortar projectiles.

Despite facing serious resource constraints at various points in their territorial expansion and contraction, IS became adept at addressing gaps in its conventional arms capabilities by deploying a range of novel weapons such as suicide vehicle-borne improvised explosive devices (SVBIEDs), munitions dropped from unmanned aerial vehicles (UAVs), improvised rocket-assisted munitions (IRAMs), and other craft-produced and improvised arms and munitions. IS proved adept not only at originating new designs, but also iterating on those designs that originated elsewhere. This latter practice is reflected in the IS design, production, and use of SVBIEDs (see *Figure 2.1*). Although not originally conceived by IS, the group widely and effectively employed SVBIEDs and significantly enhanced their design and capabilities. Amongst other developments, IS developed and fitted a variety of armour to vehicles,¹⁰ provided cameras to allow drivers to navigate under heavy armour, and even camouflaged some SVBIEDs so that, despite being armoured, they appeared externally similar to regular passenger vehicles. Similarly, the light recoilless guns covered in this report were mainly adapted from factory-made munitions which were converted to be fired from a single-use, craft-produced weapon system—augmenting both the anti-tank and anti-materiel capabilities of the Islamic State.



Figure 2.1 A suicide vehicle-borne improvised explosive device used by IS in Mosul, Iraq, in March 2017. Note the armoured forward section of the vehicle (source: IS media via ARES CONMAT Database).

IS often developed weapons specifically to match tactical niches that needed to be filled, such as by designing a small, improvised munition that was specifically intended to create small holes in building walls, facilitating movement in urban environments.¹¹ IS was also skilful in utilising commercial off-the-

9 ARES, 2024; Ismay, Gibbons-Neff & Chivers, 2017; Conflict Armament Research, 2017; Conflict Armament Research, 2016, p. 2.

10 Fulmer, 2016.

11 Mick F., 2024; ARES, 2024.

shelf products as necessary. For example, in an era when weaponised small UAVs were very rare, IS quickly developed, tested, and employed a range of both modified and wholly craft-produced small air-delivered munitions (see *Figure 2.2*).¹² Prior to December 2016, only a handful of munitions had been reported as dropped from UAVs in Iraq and Syria. A few dozen such attacks took place in January 2017. In February 2017 alone, however, Islamic State forces conducted more than 200 attacks using air-delivered munitions dropped from small UAVs, such as the one shown in *Figure 2.2*.¹³



Figure 2.2 An example of one of the small craft-produced munitions developed by IS: a projected rifle grenade (fired from a cup-type launcher) and later adapted for delivery by small UAVs. Note that this munition uses an AN-A1 fill produced by IS (source: ARES/confidential).

Although modified and craft-produced weapons are of course of lower quality than their factory-produced counterparts, many still proved fairly effective in the roles in which IS employed them. These munitions were manufactured in captured workshops and small factories, with IS taking particular advantage of the numerous facilities it captured during its territorial expansion in Iraq and Syria. IS expanded production to encompass a wide range of both novel designs and substitutes for conventional munitions to sustain its combat operations, either by supplementing or replacing stockpiles of factory-made ammunition as the situation and locality demanded. Although the craft-production and modification of arms and munitions was not unique to IS—indeed, the practice was fairly common across the conflicts in Iraq and Syria—the

¹² Fulmer & Jenzen-Jones, 2017, pp. 31–40.

¹³ Wright & Jenzen-Jones, 2018, pp. 53–64; Hays & Jenzen-Jones, 2018, p. 96.

scale of IS production was significant compared to other non-state actors.¹⁴ In addition to rockets and mortar projectiles in a range of sizes and a various IEDs, IS also developed craft-produced rifle grenades, hand grenades, landmines, IRAMs, small UAV-delivered munitions, fuzes,¹⁵ and other items (see *Figure 2.3*)—including the light recoilless guns and projectiles detailed in this report.



Figure 2.3 IS-designed and craft-produced rockets, pictured in in Tal Ara, Aleppo, Syria in October 2015 (source: IS media via ARES CONMAT Database).

IS Craft-produced Light Recoilless Guns

Four designs of IS craft-produced, shoulder-fired light recoilless guns have been documented in previous reports and analysis to date. Thus far, the most comprehensive public reports which examine these weapons are an article titled ‘ISIS Manufacturing & Fabrication’ published in *The Detonator*—the magazine of the International Association of Bomb Technicians & Investigators¹⁶—and a Conflict Armament Research Technical Report titled *Islamic State Recoilless Launcher Systems*.¹⁷ The authors are also aware of at least three confidential technical reports. These are referred to herein as ‘Confidential Report A’, ‘Confidential Report B’, and ‘Confidential Report C’.¹⁸ This section presents the best information currently available on the four IS craft-produced light recoilless guns discussed in available reporting, relying primarily on these three confidential reports and observations made by the authors, both in the field and arising from desk-based research. As noted, the Islamic State referred to the four designs as the “PG-7V launcher”, “PG-9 long

14 Mick F., 2023; ARES, 2024.

15 For a discussion on IS-improvised PIBD fuzes, see: Prater, 2018a, pp. 36–38, 41.

16 Prater, 2018b, pp. 20–22; 25.

17 Conflict Armament Research, 2018.

18 Confidential Report A is an October 2017 report prepared for a major intergovernmental organisation covering the photographic and technical evidence available on the Islamic State shoulder-fired launchers at the time of writing. Confidential Report B is a January 2018 report prepared for a major intergovernmental organisation that describes munitions manufactured by IS containing liquid of unknown type in Mosul, Iraq. Confidential Report C is a March 2018 report identifying the contents of similar munitions as crude chemical weapons, and describing the different munitions containing low-purity sulphur mustard, aluminium phosphate pellets, and chlorine.

range launcher” (PG-9 LR), “PG-9 short range launcher” (PG-9 SR), and “thermobaric launcher”.¹⁹ They are referred to herein as the Types 1 through 4, respectively (for a visual comparison, see *Figures 1.2 & 3.1*). A description of each Type with relevant technical specifications is presented below, and a comparison between all Types is made in *Figure 3.1* and *Table 3.1*. The munitions fired by these weapons are referred to after the same fashion (i.e., the Type 1 munition is fired from the Type 1 light recoilless gun), and are compared in *Figure 3.2*.

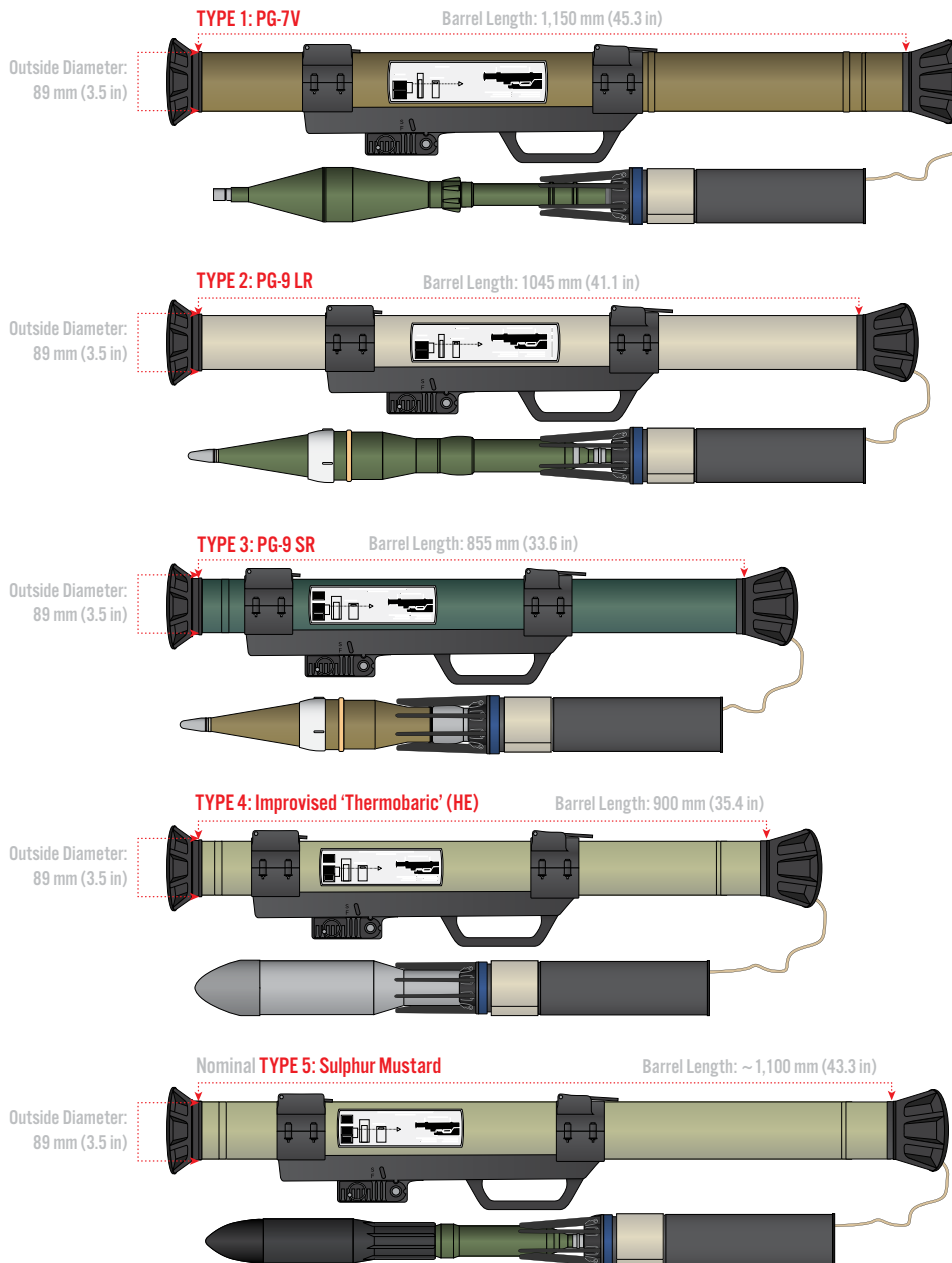


Figure 3.1 The four positively identified Types of IS shoulder-fired recoilless weapons, plus the nominal Type 5—with a sulphur mustard chemical payload—strongly suggested by the Type 5 munition identified in this report (source: ARES).

¹⁹ ARES, 2024; Prater, 2018b, p. 20.

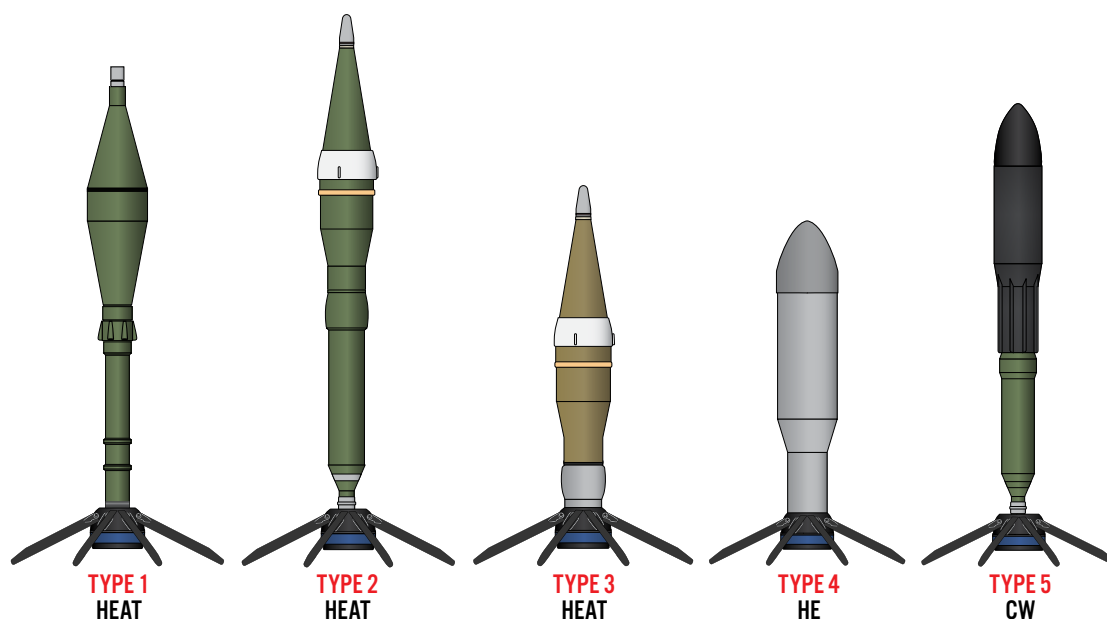


Figure 3.2 Munitions fired by the five Types of IS shoulder-fired recoilless weapons described in this report, including the Type 5—with a sulphur mustard chemical payload (source: ARES).

Table 3.1 – Islamic State Craft-produced, Shoulder-fired Light Recoilless Guns

Launcher	Diameter (outside) ²⁰	Diameter (inside)	Length (barrel)	Claimed Range
Type 1	89 mm (3.50 in)	84.5 mm (3.33 in)	1,035 mm (40.75 in)	200 m (219 yds)
Type 2	89 mm (3.50 in)	84.5 mm (3.33 in)	1,155 mm (45.47 in) (w/ endcaps)	50–700 m (55–766 yds)
Type 3	89 mm (3.50 in)	84.5 mm (3.33 in)	875 mm (34.45 in)	50–300 m (55–328 yds)
Type 4	89 mm (3.50 in)	84.5 mm (3.33 in)	900 mm (35.43 in)	Unknown
Type 5 (nominal)	89 mm (3.50 in)	Not recorded	1,100 mm (43.31 in)	Unknown

Some of the propaganda (see *Figure 3.4* for another example) associated with these weapons—as well as subsequent commentary from observers in the West—contains technical inaccuracies. Whilst English translations most often use the terms ‘launcher’ and ‘rocket launcher’ to describe the four weapons, they are all best described as light recoilless guns. Light recoilless guns are “light gun[s] of no more than 120 mm in calibre operating on the recoilless principle”.²¹ That is, they are light weapons which use the combustion of a propellant to generate high-pressure gas in a sealed chamber in order to accelerate a projectile in a controlled manner, and wherein the propellant gases (or another counter-mass, such as a powder or liquid) are expelled from the rear of the weapon’s barrel at the time a projectile is fired (see *Figure 3.3* for a demonstration of this principle with the IS recoilless guns). In recoilless guns, the forward momentum of the projectile is effectively balanced by the rearward momentum of the counter-mass, mitigating felt

²⁰ As noted, this is a nominal external diameter. Recorded examples range from 88.6 mm to 89.7 mm in diameter.

²¹ Jenzen-Jones, 2022.

recoil.²² Recoilless guns allow for comparatively heavy projectiles to be fired from man-portable weapons, and many designs also use a countermass to mitigate the backblast effect when operating in enclosed spaces.²³ Whilst the recoilless principle significantly reduces the muzzle velocity of fired projectiles, this limitation is less significant when such weapons are used in urban areas. The ability to fire projectiles with a shorter range but larger payload—and, significantly, with reduced backblast effects—was important to IS forces during the intense, urbanised combat operations in which these weapons were primarily employed, both against buildings and vehicles (see *Figure 3.5*, which shows a test against a vehicle). These weapons appear to have better backblast characteristics than either the RPG-7 or SPG-9, the two weapons that would most commonly be used to fire the PG-7V and PG-9V rounds, respectively. In particular, the extensive use of modified PG-9 munitions (see *Type 2* and *Type 3*, below) offered IS a way to make good use of a surplus of PG-9V rounds. The resultant light recoilless guns are lighter and more portable than the SPG-9, whilst also offering better characteristics for firing from confined spaces. Additionally, the SPG-9 recoilless gun was only available in comparatively limited quantities,²⁴ and several of the IS Type 2 and Type 3 recoilless guns appear to use munitions adapted from PG-15V rounds, which are typically fired from 2A28-type guns.²⁵



Figure 3.3 Two images of IS fighters firing craft-produced light recoilless guns (source: IS media via ARES CONMAT Database).

22 Jenzen-Jones, 2022, pp. 126, 131; Jenzen-Jones, 2015.

23 See: Scheiblein, 2020.

24 ARES, 2024.

25 The PG-9 projectile is common to the PG-9V and PG-15V cartridges, but uses a different expelling charge. Examples of this expelling charge, the PG-15P, were recovered from sites containing PG-9 munitions adapted for use in IS craft-produced light recoilless guns.



Figure 3.4 Top left: an IS fighter posing next to three of the four conventional variants of craft-produced light recoilless guns; bottom left: craft-produced light recoilless guns in an IS facility; right: some of the basic machining required for craft production (source: IS media via ARES CONMAT Database).



Figure 3.5 An IS Type 4 projectile about to hit a lightly armoured vehicle. The vehicle has no wheels and appears to be a test target (source: IS media via ARES CONMAT database).

Beyond the confusion between a ‘launcher’ and a ‘recoilless gun’, misunderstanding of the designs extends to the munitions, too. Two of the four designs fire munitions which incorporate a rocket motor (adapted from PG-7 or PG-9 munitions of Soviet design). Recoilless guns firing rocket-assisted projectiles are not uncommon, and the presence of a rocket motor in the munition does not render the weapon a ‘rocket launcher’.²⁶ Common examples of industrially produced recoilless weapons which fire rocket-assisted projectiles include the ubiquitous Soviet RPG-7 and German Panzerfaust 3.²⁷ It is also important to note that what IS described as a “thermobaric launcher” is a recoilless gun that fires a munition with no thermobaric properties, instead using a fairly typical improvised high explosive munition using an AN-AI fill. Finally, IS propaganda makes reference to the use of a “forced induction motor” in the PG-9 LR design; however, all recovered examples of the Type 2 use a standard PG-9 rocket motor.²⁸

Common Features & Operation

Early technical analysis conducted by ARES identified some common features of the four IS light recoilless guns. Key amongst these are the gripstock assembly with one of two trigger mechanisms, the expelling/propelling charge, the countermass, the projectile fin assembly, and the barrel with endcaps. Each of these primary components is described below, and general technical specifications are provided. Due to the craft-produced nature of these weapons and munitions, the technical specifications are only indicative and reflect the sample size available to the authors. Nonetheless, whilst the details of these components may change slightly from Type to Type, their methods of construction and technical characteristics are largely consistent.

All four Types are constructed in generally the same way and use the same ignition system. The expelling/propelling charge is mated to the countermass, with the wire for the electric match running through the length of the countermass in an off-centre rubber tube. When a recoilless gun is loaded with the charge and countermass assemblies, the wire exits through the rear of the barrel and is connected to a wire which is connected the battery and trigger in the gripstock assembly, and which runs rearward along the length of the barrel (see *Figure 3.6*).

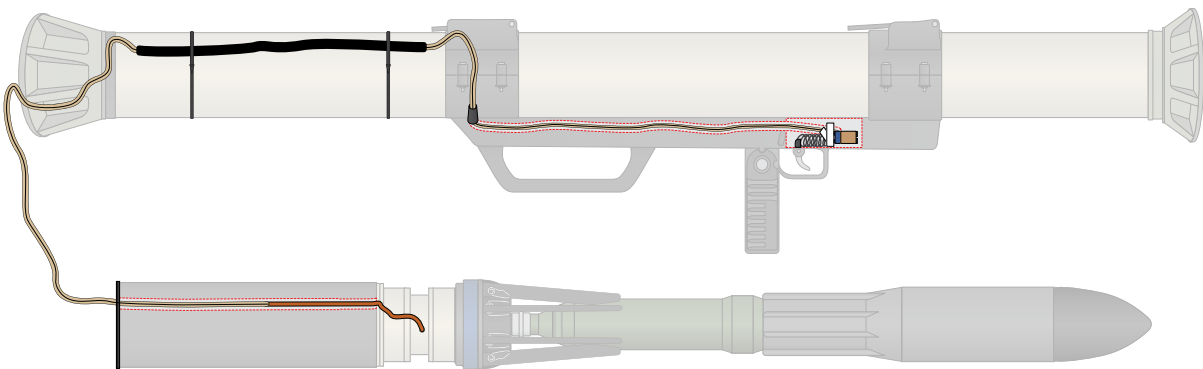


Figure 3.6 *The general arrangement of the ignition system used in the IS light recoilless guns (source: ARES).*

26 Jenzen-Jones, Ferguson & Williams, p. 182.

27 Jenzen-Jones, 2022, p. 86.

28 Prater, 2018b, p. 20; Confidential Report A.

The four Types also operate in the same way. The weapon is transported in the stowed state, with the folded pistol grip protecting the trigger and held in place by a safety pin. To prepare the weapon to fire, the operator first pulls the safety pin and unfolds the pistol grip, revealing the trigger. The sights of the weapon are aligned on the target. Where present, the safety switch is moved from the 'Safe' to 'Fire' position. Upon pressing the trigger, the firing circuit is completed. The electric match igniter ignites the photoflash powder in the central initiating chamber of the expelling/propelling charge assembly. This, in turn, ignites the propellant in the fore and aft primary propellant chambers. The frangible baseplate of the countermass assembly is blown out by the force of the rearward primary propellant charge, ejecting its contents and the remnants of the charge and countermass assemblies rearward, mitigating recoil and reducing blast effects in confined spaces. Simultaneously, the munition in the barrel is propelled forward pushing past the pre-cut rubber endcap and exiting the muzzle. Upon leaving the muzzle of the weapon, the spring-loaded fins on the projectile's fin assembly are forced into the deployed position. If the munition has a rocket motor (Types 1 and 2), this functions after a delay. Upon striking a target, the munitions for the different Types function according to their specific fuzing (see below). The fired weapon is then discarded.²⁹ It is worth noting that in May 2018, during the fighting in Mosul, one of the authors documented an IS light recoilless gun which had been emplaced such that it could be fired remotely by command wire (see *Figure 3.7*).



Figure 3.7 An IS light recoilless weapon emplaced such that it could be remotely fired by command wire. The wire originally ran down the stairs. The image below shows the weapon after it was rendered safe by an EOD team (source: ARES/confidential).

29 As noted, whilst IS did mention reloading these weapons, the evidence suggests the vast majority were treated as single-shot items.

Gripstock Assembly

All Types share the same basic gripstock assembly (see *Figure 3.8*), which is made of black plastic. Based on an examination of toolmarks and moulding features, these appear to have been made using similar or identical production processes and machines, and are approximately 514 mm (20.25 in) in length. The gripstock features a folding pistol grip which is secured in the folded position with a cotter pin and pull ring. The grip completely encompasses the trigger in its stowed position, ensuring it is not inadvertently activated during transport and handling (see *Figure 3.8*, right). The folding grip is attached to a hollow bar, the whole of which is attached to the barrel (tube) of the weapon by means of two semi-circular brackets. Each of these is matched with a separate, corresponding top segment, and each pair of brackets is secured by four machine screws with hex nuts. The bar itself contains the power supply (typically one nine-volt DC battery, but dual- and triple-battery systems have been encountered), wiring connecting the trigger switch and power supply to the electric match igniter installed in the barrel, and one of two trigger mechanisms. There were initially two different safeties observed fitted to recovered recoilless guns, but the second design appears to have been abandoned in later models.³⁰ The gripstock incorporates a simple folding leaf-type sight arrangement (see *Figure 3.9*), with instructions for sighting marked on labels affixed to the barrels of the various Types. Some of the labels also request users return the barrel after use, presumably so that it can be reloaded. In battlefield terms, the IS light recoilless guns are effectively single-use items.

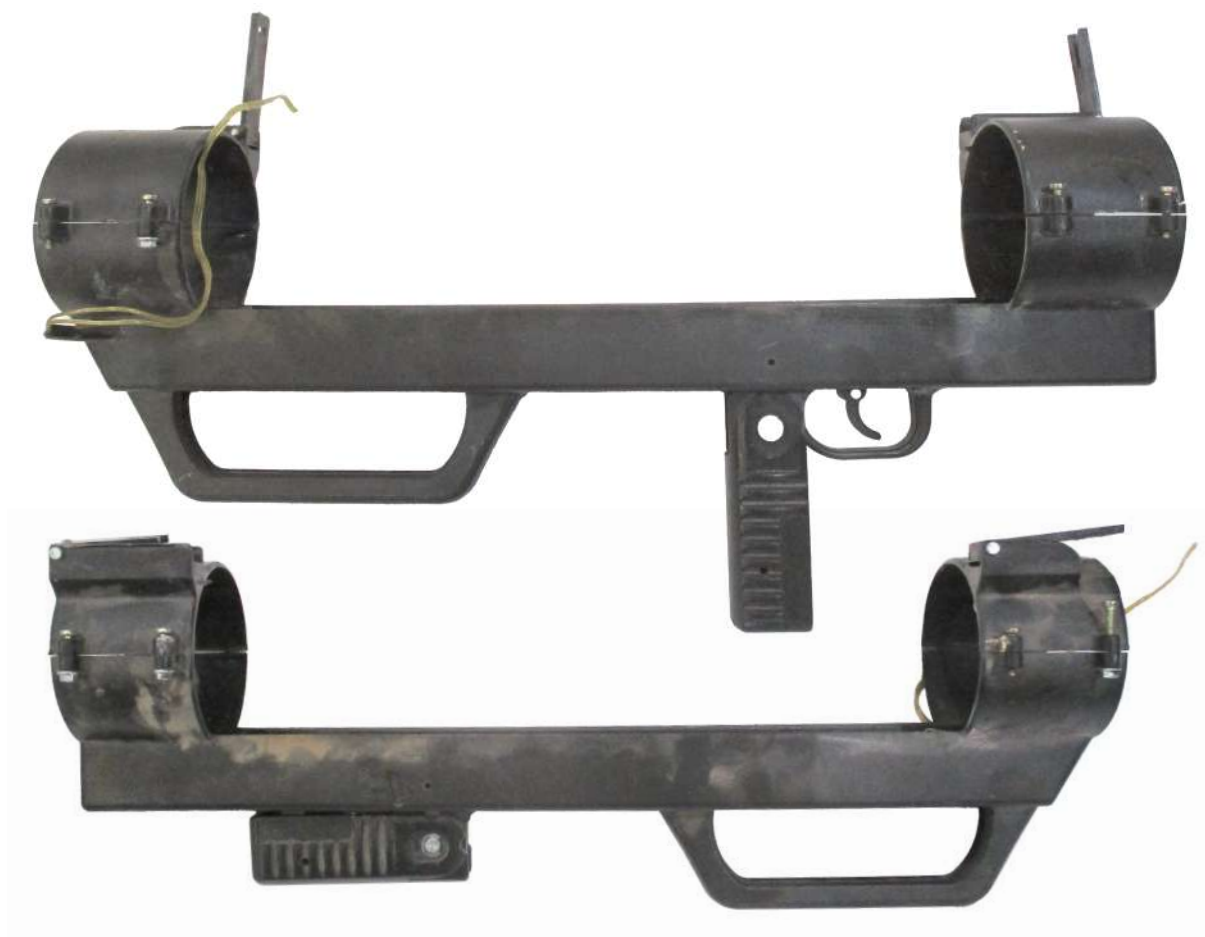
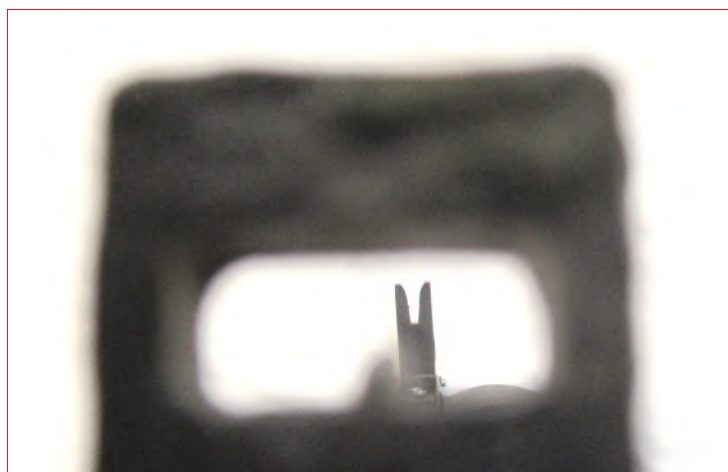


Figure 3.8 The standard gripstock assembly fitted to IS light recoilless guns, with the pistol grip unfolded (top) and folded (bottom) (source: Drew Prater).

30 Confidential Report A.

Figure 3.9 *IS recoilless gun sight alignment, as described in the printed label affixed to the weapon and shown in Figure 3.19 (source: Drew Prater).*



Both trigger mechanisms are used to ignite an electric match igniter, the common ignition system for all Types. The most common trigger mechanism utilises a coil spring with one end secured inside the bar, and the other attached to the top of the trigger, providing resistance during the trigger pull. When pulled, the trigger acts upon a push-button switch to make the final connection for electricity to flow along the wiring to the electric match igniter (see *Figure 3.13, right*). The second, less common, trigger mechanism utilises an injection-moulded switch also used as a switch in IS suicide vests/belts (see *Figure 3.10*).³¹ The top of the trigger is secured to the head of the pull switch with the pull switch offering some resistance to pulling the trigger. Once the resistance of the pull switch has been overcome by pulling the trigger, the top of the trigger depresses a mounted microswitch, completing the circuit and allowing electricity to flow to the electric match igniter.

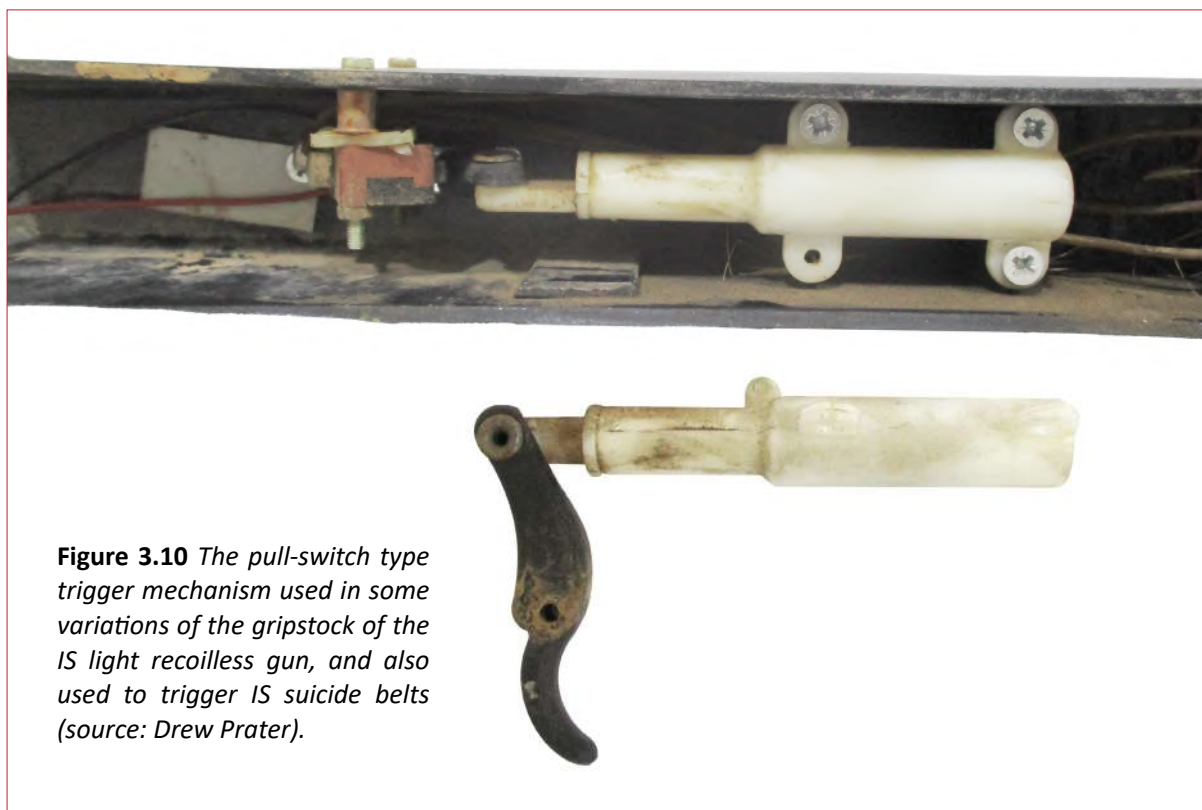


Figure 3.10 *The pull-switch type trigger mechanism used in some variations of the gripstock of the IS light recoilless gun, and also used to trigger IS suicide belts (source: Drew Prater).*

³¹ This information comes from two other confidential reports available to the authors. Testing indicated that the devices needed approximately 15–20 kg of force to function.

Propelling/Expelling Charge

The electric match igniter is used to ignite a propelling/expelling³² charge of a design that is common to Types 1 through 4 (see *Figure 3.11*). The charge assembly is constructed from three cylindrical chambers made of white plastic.³³ The two top and bottom chambers are of squat cylindrical form and are filled with smokeless powder, likely harvested from 12.7 × 108 mm and 14.5 × 114 mm cartridges.³⁴ These two propellant chambers are separated by a third cylindrical chamber of reduced diameter (giving a 'dumbbell' effect; see *Figure 3.12*), which is filled with photoflash powder and contains an electric match enclosed in aluminium foil (see *Figure 3.13*).³⁵ The central chamber is bored-through on both sides to allow the combustion of the photoflash powder to ignite the primary propellant charges in the outer chambers. Foil seals prevent the mixing of the photoflash and primary propellant powders. A hole is drilled longitudinally through the rear primary propellant chamber and into the central initiating chamber, through which the wire for the electric match is passed, with the igniter secured inside the central chamber.

The three-chamber design is used so that the central ignition chamber can simultaneously ignite the two primary propellant chambers (fore and aft) sufficient energy is directed forward to propel the projectile, and rearward to propel the countermass, mitigating felt recoil. The two larger chambers are sealed with a clear plastic film, and then enclosed by close-fitting plastic caps. The whole 'dumbbell' assembly is then secured inside of a two-piece outer sleeve of black or white plastic. The general arrangement of the assembled charge is a short cylinder, either black or white in colour. The assembled charge has a height of 62 mm (2.44 in) and a weight of roughly 168–171 g (5.93–6.03 oz), without the outer sleeve. With the black outer sleeve, the weight is approximately 280 g (9.9 oz). The white outer sleeve is approximately 57 g (2.01 oz) heavier than the black outer sleeve. With either sleeve fitted, the outside diameter of the complete charge assembly is approximately 84 mm (3.3 in).

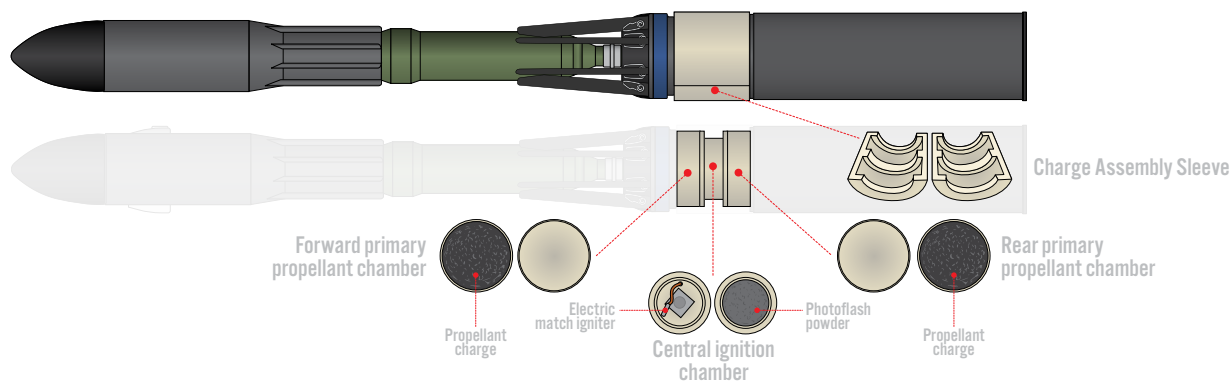


Figure 3.11 *The general arrangement of the propelling/expelling charge used in the IS light recoilless guns (source: ARES).*

32 The term 'propelling charge' is most appropriate where this charge provides the sole means of propulsion for the projectile (i.e., in the Types 3 & 4), whereas the term 'expelling charge' is appropriate where a rocket-assisted projectile is fired (i.e., in the Types 1 & 2).

33 Prater, 2018b, p. 20.

34 This is corroborated by the fact that these cartridges, with their powder charges removed, were found by one of the authors at a location where the launchers were being assembled.

35 Confidential Report A.



Figure 3.12 *The IS propelling/expelling charge, without its outer sleeve, showing the three chambers (source: Drew Prater).*



Figure 3.13 *The forward primary propellant chamber of an IS propelling/expelling charge, showing the plastic film seal and small-calibre cartridge propellant (top); the same charge disassembled to expose the photoflash powder and electric match igniter in the central initiating chamber (source: Drew Prater).*

Technical Specifications: Propelling/Expelling Charge Assembly

Diameter: 54.6 mm (2.15 in)³⁶

Height (without outer sleeve): 62 mm (2.44 in)

Weight (with outer sleeve): 280 g (9.88 oz)

Weight (without outer sleeve): 168–171 g (5.93–6.03 oz)

³⁶ This measurement is for the charge assembly with the white plastic sleeve. The black plastic sleeve was slightly larger, at 59.2 mm (2.33 in) in diameter.

Countermass Assembly

All four Types of IS light recoilless gun also employ a common countermass assembly (sometimes called a 'ballast' or 'counterweight') in order to mitigate recoil and backblast (see *Figure 3.14*), and to allow the weapon to be more safely fired in confined spaces. The forward momentum of the projectile is effectively balanced by the rearward momentum of the countermass, mitigating the otherwise-excessive recoil that firing a relatively large and heavy projectile from the gun.³⁷ The countermass assembly used in the IS light recoilless guns takes the form of cylinder made from a thin black plastic, with a frangible black plastic cover at the rearward end and a concave white plastic endcap at the forward end. Upon firing, the thin black plastic base of the cylinder will shatter and the countermass will be expelled, along with the remnants of the countermass and charge assemblies. Fired examples of the IS light recoilless guns were invariably found without the charge or countermass assemblies, or remnants thereof, in the barrels of the guns. The countermass cylinder was most often filled with approximately 20 per cent metal swarf, usually held in a clear plastic bag, and 80 per cent coarse salt, packed directly into the cylinder on top of the bag of swarf (see *Figure 3.16*). Sand (see *Figure 3.15*) or plastic pellets was used in place of salt and/or swarf in some cases. The assembled countermass assembly is approximately 290–315 mm (11.4–12.4 in) in length, 84 mm (3.3 in) in diameter, and weighs between 1.3–2.7 kg (2.87–5.95 lb), depending on the weight of the munition being fired (the heaviest countermass being used with the Type 2). The weights at the time of measurement may also vary according to the moisture content of the countermass.



Figure 3.14 The counterweight used with IS light recoilless gun designs. This example was found with a Type 3 recoilless gun. Note the wire for the electric match protruding from the base of the expelling/propelling charge (source: Drew Prater).

³⁷ Jenzen-Jones, 2022, p. 85.



Figure 3.15 Counter mass assemblies in various states of assembly in Mosul, Iraq, in February 2018. These examples contained sand as a counter mass (source: ARES/confidential).

Figure 3.16 An X-Ray image showing a VOG-25 40 mm semi-caseless medium-calibre cartridge, an RGD-4 hand grenade, an HE60 MA 60 mm mortar projectile, a 20×81 mm MG151/20 medium-calibre cartridge, and the counter mass assembly from an IS light recoilless gun. Note the division within the counter mass assembly showing the positions of the swarf (bottom, approximately 20 per cent) and salt (top, approximately 80 per cent) (source: ARES/confidential).



Technical Specifications: Countermass Assembly

Diameter: 84 mm (3.3 in)

Length: 290–315 mm (11.4–12.4 in)

Weight: 1.3–2.7 kg (2.87–5.95 lb)

Fin Assembly

The Types 1 through 4 recoilless guns also share an IS-designed fin assembly which varies slightly by weapon according to the munition being adapted (see *Figure 3.17*). The assembly comprises four major components, in addition to the eight folding fins themselves (see *Figure 3.18*). The base of the fin assembly is manufactured from turned aluminium, and surmounted by a blue plastic, single-acting piston rod seal with a black rubber obturating ring that acts as a gas seal.³⁸ The gas seals were produced by Kastas, a Turkish company, and were most likely used by the Iraqi oil and gas industry. The gas seal is very efficient and holds the projectile securely in the barrel with no possibility of movement, which complicates safe extraction of the munition during disassembly. Atop the piston rod seal sits a black plastic fin base, which provides pivot points and retains the springs for each fin. A threaded, flanged aluminium collar secures the assembly, mating with the base piece. Once a projectile is loaded, the spring-loaded fins are held in their forward, undeployed position by the barrel. Immediately upon leaving the barrel, the springs (assisted by air movement during firing) push the fins into their deployed position. Once assembled, the fin assembly also mounts the adaptor for each projectile, threading it in securely. Each munition uses a different adaptor to accommodate its unique physical characteristics (e.g., there is a hole in the base of the adaptor for the Type 2 to allow exhaust gases to vent from the venturi; in the Type 4, the adaptor contains the base-detonating fuze; etc.).



Figure 3.17 The standard IS light recoilless gun tailfin assembly, with the fins removed (source: Drew Prater).

³⁸ Prater, 2018b, pp. 20–21.



Figure 3.18 The base of the fin assembly, disassembled (source: Drew Prater).

Technical Specifications: Fin Assembly

Base Plate

Diameter (base): 80.0 mm (3.15 in)
Diameter (threaded section): 38.1 mm (1.5 in)
Diameter (internal opening): 20.2 mm (0.8 in)
Height: 31.3 mm (1.23 in)
Weight: 150 g (5.29 oz)

Flanged Seal

Diameter (internal): 62.8–64.7 mm (2.47–2.55 in)
Diameter (external): 83.8 mm (3.3 in)–85.9 mm (3.38 in)
Diameter (O-Ring seal): 4.2 mm (0.17 in)
Height: 10.2 mm (0.4 in)
Weight: 30 g (1.06 oz)

Fin Holder

Diameter (internal): 43.8 mm (1.72 in)
Diameter (external): 82.4 mm (3.24 in)
Diameter (base, external): 62.9 mm (2.48 in)
Height (overall): 38.3 mm (1.51 in)
Height (base): 9.7 mm (0.38 in)
Weight: 113 g (3.99 oz)

Threaded Cylinder

Diameter (inner): 37.3 mm (1.47 in)
Diameter (outer): 42.5 mm (1.67 in)
Diameter (flange): 47.6 mm (1.87 in)
Height (overall): 37.9 mm (1.49 in)
Height (flange): 4 mm (0.16 in)
Weight: 78 g (2.75 oz)

Barrel & Endcaps

The four conventional Types of light recoilless gun also feature very similar barrels (sometimes informally called 'launch tubes'), all of which are of the same nominal diameter and made from the same seamless metal tubing, with an outside diameter of approximately 89 mm (3.50 in) and an inside diameter of approximately 84 mm (3.31 in). The barrels are generally painted in tan, olive drab, or one of at least two shades of darker green, but numerous examples have been seen unpainted (with a bare metal finish). As the colours of the barrels and the munitions are variable (the latter with manufacturer, model, etc.) even within a single Type, colour is not a diagnostic identification feature for IS recoilless guns or their projectiles.³⁹

The barrels are sealed with a common set of rubber end caps to prevent the ingress of foreign objects and contaminants.⁴⁰ The endcaps are pre-cut to allow the projectile to pass easily. One or both were often missing from weapons located in the field (especially where fired). Printed instructions for use (see *Figure 3.19*) were affixed to some barrels, which identify the functional type of the projectile loaded in a given gun (in the case of the Type 4, incorrectly), the weapon's range, preferred targets, and a diagram depicting correct sight alignment.⁴¹ This parallels the instructions marked on broadly equivalent industrially produced weapons, such as the Swedish AT4.

³⁹ Projectile colours and markings also varied according to the 'donor' munition (in the case of modified conventional munitions) or construction materials (in the case of craft-produced munitions).

⁴⁰ Confidential Report A.

⁴¹ Other examples are recorded in: Conflict Armament Research, 2018, Annex.



Figure 3.19 Instructions for use printed on a Type 3 IS light recoilless gun (source: Drew Prater).

Type 1 ('PG-7V')

The Type 1 light recoilless gun (see Figure 3.20) fires a slightly modified PG-7-type 40 mm⁴² fin-stabilised, high explosive anti-tank (HEAT) projectile, which is fitted with a VP-22-type point-initiating, base-detonating (PIBD) fuze.⁴³ This munition carries a shaped-charge warhead that is intended for use against lightly armoured vehicles. The PG-7⁴⁴ rocket's percussion primer has been removed and the motor has been threaded internally, which allows the IS improvised fin assembly to be attached.⁴⁵ It is equipped with this fin assembly, as described above, with no modifications, unlike two of the other recoilless guns.⁴⁶ The barrel of Type 1 is slightly longer than those of the other recoilless guns, at 1,035 mm without end caps and 1,152 mm with end caps.⁴⁷ The Type 1 is fitted with the standard gripstock assembly, as described above. It has a reported range of 200 m.⁴⁸

42 When describing munitions fired by a light recoilless gun, it is convention to designate them by the (often nominal) diameter of the barrel, even where such munitions are 'over-calibre' for the weapon. This is the case for the RPG-7 and PG-7 combination, for example. The 40 mm calibre designation for the PG-7 is included here for reader familiarity, although the modified munition should properly be considered by its warhead diameter (~85 mm).

43 Prater, 2018b, p. 21.

44 Note: when referring to projectiles of the Soviet Union or Warsaw Pact (and some successor states), the 'V' in a given designation stands for *vystrel*, or 'round', and refers to the combination of projectile and propelling/expelling charge (Jenzen-Jones, Ferguson & Williams, 2018, p. 219). Hence 'PG-7' refers specifically to the projectile alone, while 'PG-7V' refers to the round in its entirety including the expelling charge (the PG-7P), whether assembled or not. The IS designation of the Type 1 recoilless gun as the 'PG-7V' is thus inaccurate.

45 The authors have encountered a single example of a Type 1 munition that used a modified Bulgarian PG-7, with an extended body section that was filled with an AN-AI explosive composition. It had not been fired, and it is unclear why the round was modified in this way.

46 Prater, 2018b, p. 20.

47 These measurements are, by necessity, estimates, as poor Islamic State production quality (at least relative to industrial standards) leads to slight differences between examples of the same Model.

48 According to the printed label affixed to the weapon.



Figure 3.20 The Type 1 ('PG-7V') IS light recoilless gun and its Type 1 munition. Note that what appears to be a silver 'band' on the munition warhead is actually the result of the green paint being abraded from the projectile due to the very tight fit between the PG-7 warhead (~85 mm) and the tube (internal diameter of ~84.5 mm) (source: Drew Prater).

Technical Specifications: Type 1 Recoilless Gun

Diameter (outside): 89 mm (3.50 in)

Diameter (inside): 84.5 mm (3.33 in)

Length (barrel): 1,035 mm (40.75 in)

Length (overall): 1,152 mm (45.35 in)

Claimed range: 200 m (219 yds)

Type 2 ('PG-9 LR')

The Type 2 light recoilless gun (see *Figure 3.21*) fires a slightly modified PG-9-type 73 mm fin-stabilised HEAT projectile, which is fitted with a VP-9-type PIBD fuze.⁴⁹ The Type 2 externally resembles the Type 1 recoilless gun, despite firing a different projectile. The 'long range' suffix used in IS social media posts and refers to its claimed range of 50 to 700 metres.⁵⁰ The Type 2 has roughly the same barrel length as the Type 1 recoilless gun, at 1,035 mm (another report puts it at 1,045 mm). With end caps, the overall length is 1,155 mm—also roughly equivalent to that of the Type 1. The Type 2 projectiles observed by the authors have the expected silver-coloured VP-9 nose fuze⁵¹ and plastic obturating band, but feature an additional plastic centring ring (collar) placed around its ogive to keep it centred in the barrel (see *Figure 3.22*).⁵² Like the Type 1, the Type 2 is equipped with the standard gripstock assembly. The Type 2 projectile features the IS improvised fin assembly, although part of the base plate is removed to allow for the propellant gasses to vent through the venturi.⁵³ This difference in design is due to the Type 2's PG-9 rocket motor venting directly to the rear, while the Type 1's PG-7 rocket motor has multiple venturi positioned behind the warhead, angled to the sides.

49 Prater, 2018b, p. 21.

50 According to the printed label affixed to the weapon.

51 All examples of loaded Type 1, Type 2, and Type 3 launcher observed by the authors show that the VP-22/VP-9 transport caps had been removed prior to loading.

52 Prater, 2018b, p. 21.

53 *Loc. cit.*



Figure 3.21 The Type 2 ('PG-9 LR') IS light recoilless gun and its Type 2 munition (source: Drew Prater).

Type 2 Recoilless gun Technical Specifications

Diameter (outside): 89 mm (3.50 in)

Diameter (inside): 84.5 mm (3.33 in)

Length (barrel): 1,045 mm (41.5 in)

Length (overall): 1,155 mm (45.47 in)

Claimed range: 50–700 m (55–766 yds)



Figure 3.22 The plastic collar (centring ring) which is place around the ogive of the Type 2 and Type 3 projectiles to centre it in the barrel of the recoilless gun (source: Drew Prater).

Type 3 ('PG-9 SR')

The Type 3 light recoilless gun (see *Figure 3.23*; see *Figure 3.24* for a Type 3's sight alignment) fires a modified PG-9-type 73 mm fin-stabilised HEAT projectile, which is fitted with a VP-9-type PIBD fuze.⁵⁴ As with the Type 2 projectile, the Type 3 projectile is fitted with a collar around its ogive to centre the munition within the gun's barrel.⁵⁵ Unlike the Type 2 projectile, however, the Type 3 projectile makes use only of the *warhead* from a PG-9-type projectile, rather than the entire projectile assembly. Accordingly, the Type 3's 'short range' (SR) suffix refers to its claimed range of 50 to 300 metres—significantly shorter than the Type 2's claimed upper limit.⁵⁶ The overall length of the Type 3's olive-coloured barrel is significantly shorter than those of the Type 1 and Type 2, at 857 mm.⁵⁷ It also features the standard gripstock assembly found on the first two IS light recoilless gun models.⁵⁸ The Type 3 projectile has the standard PG-9 fins removed and replaced with the improvised IS fin assembly by way of an adaptor, which secures the warhead section to the fin assembly rather than the former being directly threaded into the latter.⁵⁹



Figure 3.23 The Type 3 ('PG-9 SR') IS light recoilless gun and its Type 3 munition (source: Drew Prater).

Type 3 Recoilless gun Technical Specifications

Diameter (outside): 89 mm (3.50 in)

Diameter (inside): 84.5 mm (3.33 in)

Length (barrel): 875 mm (34.45 in)

Claimed range: 50–300 m (55–328 yds)

⁵⁴ *Loc. cit.*

⁵⁵ *Loc. cit.*

⁵⁶ According to the printed label affixed to the weapon.

⁵⁷ Prater, 2018b, pp. 20–21; Confidential Report A. Conflict Armament Research, 2018, p. 9 states 875 mm, but this is likely a typographical error.

⁵⁸ Confidential Report A.

⁵⁹ *Loc. cit.*

Figure 3.24 *The sights lined up on a Type 3 light recoilless gun (source: Drew Prater).*



Type 4 ('Thermobaric')

The final model of light recoilless gun (see *Figure 3.25*) has been referred to in IS social media posts as a “thermobaric launcher”,⁶⁰ but it actually fires a wholly craft-produced, fin-stabilised HE projectile fitted with an impact-inertia base fuze (see *Figure 3.26*).⁶¹ The body of the projectile is made of aluminium and has a frangible black plastic nose cap.⁶² The projectile’s fin assembly is largely the same as the standard assembly described above, but incorporates a base-detonating fuze not found in the other fin assemblies. This relatively simple fuze has a basic firing pin, a small arms percussion primer, a non-electric blasting cap, and other rudimentary components. The firing train is aligned upon manufacture, with the arrangement as follows: The weighted firing pin is restrained only by a thin, black plastic membrane and is aligned with the percussion primer and non-electric detonator. A white plastic cylinder holds the percussion (shotgun) primer and has an inner black plastic cylinder which contains the non-electric detonator that is surrounded by black electrical tape, securing four lengths of detonating cord. At the top of the detonator is a cut-off nail which retains the detonator during impact, allowing it to function rather than being moved forward by impact-inertia forces. Upon impact, the weighted firing pin overcomes the structural integrity of the plastic membrane and impacts the percussion primer. The warhead uses an AN-AI main charge, initiated by four lengths of detonating cord that assist in the simultaneous and complete functioning of the projectile’s main charge (see *Figure 3.27*).⁶³ The barrel of the Type 4 light recoilless gun is similar to that of other Types, being relatively short (around 900 mm).⁶⁴ It is fitted with the same standard gripstock assembly as the other three recoilless guns. Interestingly, the instruction label affixed to the Type 4 recoilless gun indicate that it

60 Thermobaric weapons contain explosive payloads designed to detonate in a way that optimises both heat and blast effects on targets by utilising ambient oxygen from the surrounding air. They are characterised by larger fireballs, longer blast durations, and larger blast radii than conventional high explosive munitions, achieved by using relatively oxygen-deficient explosives that, unlike those compositions used in standard warheads, release their energy comparatively slowly after detonation. Whilst many thermobaric weapons used metallic oxidisers, in this case the aluminium functions as a fuel.

61 Prater, 2018b, p. 20; Confidential Report A.

62 Prater, 2018b, p. 21.

63 *Loc. cit.*

64 *Loc. cit.*

is intended for use against buildings,⁶⁵ as would be expected from a ‘true’ thermobaric weapon—possibly indicating that the IS developers believed they had successfully developed such a munition.



Figure 3.25 The Type 4 (‘Thermobaric’; actually HE) IS light recoilless gun and its Type 4 munition. Note the gripstock assembly is absent from this example (source: Drew Prater).



Figure 3.26 Two images of the Type 4 projectile. Note the fully extended fins in the right-hand image (source: Drew Prater).

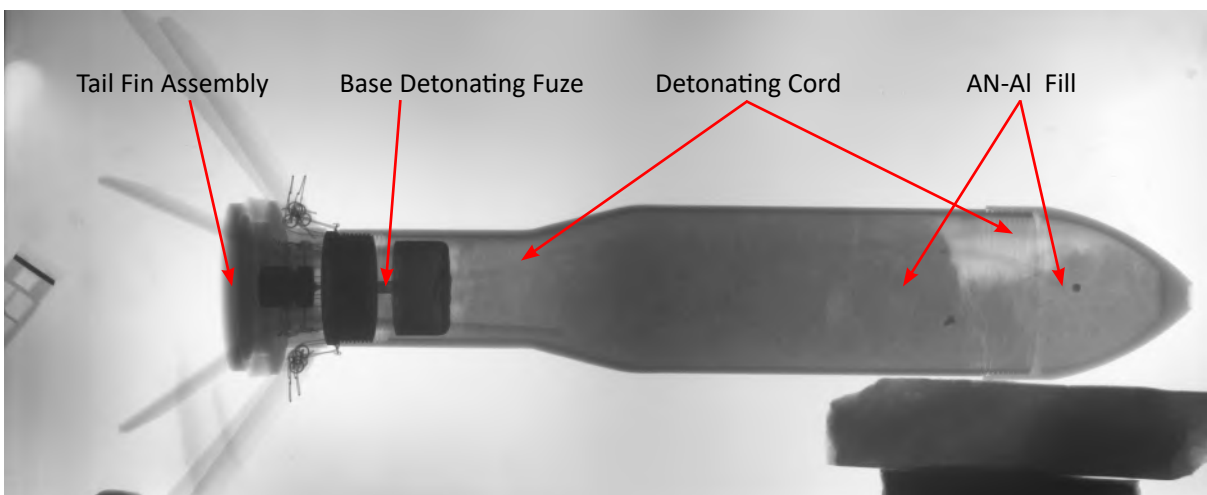


Figure 3.27 A labelled X-ray image showing the general construction of the Type 4 projectile (source: ARES/ confidential).

65 Loc. cit.

Technical Specifications: Type 4 Recoilless Gun

Diameter (outside): 89 mm (3.50 in)
Diameter (inside): 84.5 mm (3.33 in)
Length (barrel): 900 mm (35.43 in)
Claimed range: Unknown

Technical Specifications: Type 4 Projectile

Diameter: 79 mm (3.11 in)
Length (overall): 468 mm (18.43 in)
Length (warhead): ~320 mm (~12.6 in)
Length (fins): ~50 mm (~1.97 in)
Weight (total): 1,732 g (3.82 lb)
Functional type: High explosive (HE)

Islamic State Chemical Weapons Production

In addition to their significant conventional arsenal, IS spent considerable time, energy, and resources on the procurement, weaponisation, and employment of chemical weapons (CW).⁶⁶ Its predecessor groups—most notably the loose affiliation of Islamists generally led by Abu Musab al-Zarqawi that later became al-Qaeda in Iraq—had been weaponising chlorine in SVBIEDs since at least the early 2000s.⁶⁷ However, a real shift in capability came with the establishment of IS in 2014 by new leader Abu Bakr al-Baghdadi. As with the enhanced production of conventional munitions, the capture of significant territory in Iraq and Syria provided the group with access to a range of critical resources required to manufacture CW, including precursor chemical, tools and equipment, and personnel. Most relevant here was access to Saddam-era Iraqi CW manufacturing sites as well as the capture of Mosul University in 2014.⁶⁸ With its wide range of facilities and personnel, the university became the centre of the group's CW programme over the next three years—reportedly relying on the coerced help of university staff in CW development.⁶⁹

Strack's comprehensive overview of the IS CW programme⁷⁰ has identified three major phases: The first, spanning from 2014 (including the fall of Mosul to IS) through June 2015, was characterised by the use of IEDs (vehicular or otherwise) loaded with a chlorine or phosgene payload.⁷¹ This phase was more or less a continuation of al-Qaeda in Iraq's earlier experimentation with CW IEDs, is notable only by comparison with later phases. The bulk of the IS CW programme comprises the second phase, which spanned from July 2015 to January 2017. This period began with the organisation's first documented use of a CW *projectile* (most likely a mortar projectile) near Hasakah, Syria.⁷² This projectile likely contained industrial phosphine, but IS soon shifted to primarily using sulphur mustard payloads that they themselves manufactured through the so-called Levinstein process, as corroborated by sources available to ARES and the Organisation for the Prohibition of Chemical Weapons (OPCW).⁷³ Levinstein-type sulphur mustard (especially when produced outside of an industrial setting) is significantly less pure than, and thus easily distinguishable from, state-produced mustard agents from Iraq and Syria, which is produced through the Meyer process.⁷⁴ IS-made mustard agent was delivered by a wide range of craft-produced and modified conventional projectiles,

66 This section is adapted, in part, from a confidential background paper prepared by ARES in 2022–2023.

67 Quillen, 2016, pp. 1,020–1,023; Bunker, 2019, pp. 12–13.

68 OPCW Technical Secretariat, 2024, p. 68; Quillen, 2016, pp. 1,024–1,025; Bunker, 2019, pp. 14–16.

69 Associated Press, 2017, UN, 2023.

70 Strack, 2017, p. 19.

71 *Loc. cit.*; Binder, Quigley & Tinsley, 2018, p. 28.

72 Binder, Quigley & Tinsley, 2018, p. 28.

73 OPCW Technical Secretariat, 2024, pp. 28–35.

74 *Op. cit.*, pp. 30, 40–42.

including mortar and artillery projectiles,⁷⁵ as well as rockets.⁷⁶ This second phase encompasses the majority of IS chemical attacks, which peaked in April 2016 when the group committed at least eight CW attacks.⁷⁷

IS chemical agent production techniques (at least as pertains to sulphur mustard) appear to have been refined around the time of the 1 September 2015 attack on Marea (Mare), Syria. According to an OPCW report on the attack, prior to September 2015, many IS improvised projectiles containing sulphur mustard left yellow powder residue behind. This is indicative of too much sulphur being used in the Levinstein process relative to other components.⁷⁸ The Marea attack featured some munitions which left this powdery yellow residue, but also others which left behind a black, tar-like substance. According to chemists consulted by the OPCW, this reflects a more refined process of improvised Levinstein mustard production.⁷⁹ Future IS attacks using sulphur mustard featured exclusively the black tar-like residue.⁸⁰ This, while the black tar-like residue still shows the limitations of IS's improvised sulphur mustard (industrially pure sulphur mustard is nearly colourless), its presence instead of the yellow powder indicates that the Marea attack was a turning point within the second phase of IS chemical weapons development. The third and final phase of the IS CW programme covers the period from January 2017 to July 2017, which is when the organisation's last known CW attacks occurred.⁸¹ With the recapture of Mosul in July 2017 and coalition airstrikes that targeted Mosul University, the Islamic State's ability to produce CW was neutralised. As such, their CW programme all but ceased as of July 2017, although it is likely IS would seek to restart production if possible.

Over the course of its CW programme, IS made use of various chemical agents and delivery mechanism. This diverse approach is broadly consistent with their craft-production of conventional arms and munitions, as described above. Unlike the Government of Syria, IS never fully standardised on one or two CW munitions; rather, they manufactured everything from mortar projectiles to hand-thrown containers to rockets, each filled with one (or potentially multiple) CW agents from a variety of available options (see *Figure 4.1*).⁸² This lack of standardisation is probably the result of several factors, including the irregular production capacity and dispersed facilities that defined IS arms production, as well as attempts to iterate on novel designs and test these prior to standardisation, as can be seen to some extent in the group's refinement of the Levinstein process. Once designs were known to work as desired, IS production appears to have increasingly standardised around these. The most common chemical weapons employed by IS were improvised projectiles filled with sulphur mustard produced through the Levinstein process.

75 As seen in the September 2015 Marea attack. See *Op. cit.*, 2024, p. 65.

76 Strack, 2017, p. 19; Cancian, 2017, pp. 58–59.

77 Strack, 2017, p. 19.

78 OPCW Technical Secretariat, 2024, pp. 39–40.

79 Specifically, the lack of yellow powder and appearance of the tar-like substances “indicates that the perpetrators had improved the method used for converting sulfur into its sulfur chlorides” during the Levinstein process (*Op. cit.*, p. 40).

80 *Loc. cit.*

81 Strack, 2017, p. 19.

82 Ismay, Gibbons-Neff & Chivers, 2017.



Figure 4.1 Examples of CW projectiles manufactured by IS: Several plastic bottles labelled to indicate they contained aluminium phosphide, fitted with safety fuse (top left); a mortar projectile filled with lye (top right); several bottles filled with a toxic substance (probably a mustard agent) (bottom left); a chlorine-filled gas canister used as part of a VBIED (bottom right) (sources: ARES/confidential; ARES CONMAT Database).

In addition to the Type 5 CW munition described below, the authors encountered devices referred to colloquially as “chemical molotovs” in Mosul, Iraq, in late 2017 (see *Figure 4.2*). These crude chemical devices were simply glass beverage bottles filled with a chemical payload and sealed with corks, sealants, and tape to keep the contents confined. Evidence of their production and use was found throughout the Old City of Mosul. Whilst the hand-thrown devices were intended to shatter upon impact, it appears that many were sturdy enough that throwing them did not always result in them breaking when they hit a target, wall, or the ground. Several chipped or cracked, but largely unbroken, examples were seen by the authors. These devices are believed to have been filled with sulphur mustard produced through the Levinstein process.

Figure 4.2 Crude frangible chemical ‘molotovs’ as used by IS forces in Mosul from late 2017, pictured in the Al Maidan district in April 2018 (source: ARES/confidential).



IS Projectiles with CW Warheads

Beginning in early 2017,⁸³ teams of IED technical specialists on the ground in Mosul, Iraq began to encounter IS-manufactured munitions filled with “a liquid of unknown type” that was believed to be a mustard agent.⁸⁴ In November 2017, an EOD team led by one of the authors found a metal tube loaded with what was later determined to be a craft-produced, rocket-assisted chemical munition (see *Figures 5.1*) in Mosul. The loaded tube was found, abandoned, near a more sophisticated improvised launcher that was loaded with what was believed to be a French 68 mm conventional rocket. A plastic warhead was visible inside the open front end of the tube (see *Figure 5.2*). In the same area as the loaded tube and improvised launcher was an expelling or propelling charge that strongly resembles those used with the four IS craft-produced light recoilless weapons (see *Figure 5.3*). The munition was handed over to the Iraqi Army and destroyed.



Figure 5.1 A possible recoilless gun barrel, loaded with a chemical munition, discovered in Mosul in November 2017 by an EOD team led by one of the authors (source: ARES/confidential).



Figure 5.2 A tube (probable recoilless gun barrel) with an unidentified munition with a plastic warhead loaded inside, encountered in Mosul in November 2017 by an EOD team (source: ARES/confidential).

83 Confidential Report C. A similar black, viscous liquid later determined to be sulphur mustard was previously associated with IS munitions used in Syria in the latter half of 2016.

84 Confidential Report B.



Figure 5.3 A propelling charge that strongly resembles that used in the IS craft-produced light recoilless guns, found near the site of the chemical munition inside the tube in November 2017 (source: ARES/confidential).

In December 2017, more than 25 similar munitions were recovered from within the city (see *Figure 5.4*). Due to a strong petroleum-like smell and cold temperatures that inhibited the action of the chemical agent, an incendiary fill was initially suspected. Members of the clearance team later exhibited physical symptoms consistent with a chemical agent, including burns and blisters on their skin. When the casualties were treated at a local hospital, doctors told one of the authors that there had been “hundreds” of similar cases amongst the civilian population. Around this time, glass beverage bottles filled with a similar black, viscous liquid (see *Figure 4.2*) were regularly encountered by clearance teams in Mosul. This is believed to be sulphur mustard produced through the Levinstein process. In February 2018, an EOD team discovered an IS chemical weapons filling facility in West Mosul. Mustard agent present at the facility had been produced elsewhere, and transported in large, blue-plastic jugs common in the region. Around this time, a remote-detonated IED with a sulphur mustard payload was also identified in Mosul, as were four further bottles of suspected mustard agent.⁸⁵

⁸⁵ Author interviews with confidential sources.



Figure 5.4 Numerous Type 5 projectiles and components thereof, pictured in Mosul in late 2017 (source: ARES/confidential).

Both in terms of their physical characteristics and the presence of the then-unidentified substance, it was apparent that the new munitions—whilst visually similar (see *Figure 5.5*)—were not one of the four conventional projectile Types fired by the IS light recoilless guns as described above. The first of two confidential reports on these munitions (Confidential Report B) was completed in early 2018, and offered some preliminary information on one example of the suspected chemical munition. The technical team reported that this munition featured a plastic warhead affixed to the flight motor taken from a PG-9 rocket-assisted projectile. This arrangement is similar to that of the four IS craft-produced recoilless projectiles described above, and the munition is thus referred to herein as the Type 5 munition. Importantly, the munition had no mechanical fuzing internally.⁸⁶ According to X-ray images made by the team (see *Figure 5.9*), the munition contained a “[plastic] bottle or container...wrapped in an unknown substance...”, which itself contained liquid that could not be identified by preliminary analysis.⁸⁷ The team concluded that the munition likely functioned “by breaking or shattering on impact with a hard target, releasing [its] contents”.⁸⁸ One report posits that the interior container was likely to be eroded by the mustard.⁸⁹

86 Confidential Report B.

87 *Loc. cit.*

88 *Loc. cit.*

89 Confidential Report C.



Figure 5.5 A probable CW munition (second from top) encountered by an EOD team in Mosul, Iraq, in 2017 (source: Drew Prater).

Following the discovery of the Type 5 munition, EOD and demining personnel operating in formerly-held IS territory—including those advised by two of the authors of this article—were instructed to check any recovered IS light recoilless gun for the presence of a chemical round, which was done by visually inspecting the inside of the muzzle for a plastic warhead nose. To avoid possible chemical contamination and injury, standard operating procedure was to consider any light recoilless gun munitions with plastic warheads as chemical weapons until proven otherwise. A second report (Confidential Report C) was issued two months later. This summary report contains more specific information on the nature and contents of various IS-made chemical munitions that had been encountered up to that time. Three chemical fillings were identified: sulphur mustard, aluminium phosphide,⁹⁰ and chlorine gas.⁹¹ It was determined that the liquid contained in craft-produced munition described in Confidential Report B was sulphur mustard, an OPCW Schedule 1⁹² blister agent widely used during the First World War⁹³ and known by this point to have been used by the Islamic State in several attacks.⁹⁴ The sulphur mustard, as used in “improvised plastic warheads fitted to PG-7 and PG-9 rocket motors”, was determined to be of “35% purity”—making it rather potent by the standards of IS CW munitions, especially considering the munitions’ “months of degradation from improper storage”.⁹⁵ Recovered munitions were noted to have smelled of garlic and petroleum, and, reflecting this, the sulphur mustard payload was determined to have included petroleum products as well—substances with little use as a CW agent. This apparent dilution of the mustard agent with petrol products may have been an attempt to stretch a remaining stock of chemical agents further, an attempt to make the agent more persistent, or a combination of these two motivations.

90 IS munitions were found loaded with aluminium phosphide pellets surrounded by frangible vials of water. Upon impact, the vials would have shattered, allowing the pellets and the water to mix and occasioning a reaction that releases toxic phosphine gas. Phosphine is a pulmonary agent that primarily attacks the respiratory and cardiovascular systems. Aluminium phosphide pellets are commonly used as a fumigant pesticide. See: Public Health England, 2019.

91 Chlorine gas was found in various munitions, from improvised rockets to vehicle-based improvised explosive devices (VBIEDs).

92 OPCW, n.d.

93 For more information, see, for example: Borak & Sidell, 1992, pp. 303–308.

94 Strack, 2017.

95 Confidential Report C.

Further Type 5 munitions were encountered in Iraq throughout 2018 (see *Figures 5.6 & 5.7*). During the cold winter months, the vapours generated by the munitions were detectable but tolerable; during the summer months, it became much harder to deal with the items without wearing protective equipment. Although several NGOs and private companies operating in Northeast Syria—another area contested and sometimes held by IS—encountered 220 mm mortar projectiles filled with mustard agent, the smaller Type 5 chemical munitions do not appear to have been distributed there. This may indicate that the munitions were developed towards the end of the period during which IS exercised significant territorial control, after the group had been largely displaced from Syria.



Figure 5.6 A Type 5 chemical munition pictured at Al Shifa Hospital, Mosul, in March 2018 (source: ARES/confidential).



Figure 5.7 Two Type 5 chemical munitions documented under a bridge in West Mosul, in May 2018 (source: ARES/confidential).

Type 5 (Chemical)

The metal tube loaded with the chemical munition depicted in *Figure 5.2* is the only photographic evidence of a nominal Type 5 light recoilless gun known to the authors.⁹⁶ The proximity of an expelling or propelling charge very similar to those described in this report provides further circumstantial evidence for the Type 5 light recoilless gun's existence. Evidence for the Type 5 munition, however, is conclusive. The general arrangement and construction techniques used in producing the Type 5 munition (see *Figure 5.8*) strongly suggest that it was intended to be fired from a light recoilless gun very similar to those described in this article. The tube containing the munition was of the same approximate diameter as the barrels of all four models of IS craft-produced light recoilless guns, and the munition itself is visually similar to the Type 4 craft-produced HE round. It is fitted with the same IS-developed fin assembly, and mated to either PG-7 or PG-9 projectile rocket motors.⁹⁷ The tube itself is similar to recoilless gun barrels; notable is the overall length of the tube (approximately 1,100 mm) and the groove cut into both ends of the tube, both of which are generally consistent with other IS produced recoilless guns. As noted, numerous effectively identical examples of the Type 5 munition were recovered in 2017 and 2018, suggesting standardised production in line with the other Types described herein. The defining feature of the Type 5 munition is a rounded, smooth-nosed plastic warhead that, if loaded as seen in the one recovered tube, could be observed from the open front end of the barrel of the nominal Type 5 recoilless gun. The plastic nose of the Type 5 munition is distinctive, and EOD teams operating in Iraq considered this a key ID feature for possible chemical munitions.



Figure 5.8 A Type 5 chemical munition. Note the flight motor taken from a PG-9 rocket-assisted munition mated to a craft-produced body (source: Drew Prater).



Figure 5.9 An X-ray image showing the contents of a Type 5 munition believed to contain sulphur mustard (source: ARES/confidential).

⁹⁶ Should a reader be aware of other examples of Type 5 munitions loaded into tubes/barrels (or, indeed, complete recoilless guns), please contact the authors via: contact@armamentresearch.com

⁹⁷ Conceivably, some of the Type 5 rounds may have been constructed using PG-9 rocket motors left over from the production of Type 3 munitions. Alternatively, the development of the Type 3 munition may represent an attempt to repurpose left-over PG-9 projectile warheads from the construction of Type 5 projectiles.

It is not known whether or not the Type 5 munition was ever fired by IS forces in combat. The fragile plastic construction of the Type 5 warhead may well pose a significant hazard to the operator during transport and under combat conditions, especially upon firing. Additionally, none of the Type 5 munitions identified by ARES were marked or labelled to indicate a chemical payload; it is likely that many further examples were destroyed by Iraqi security forces assuming they were conventional munitions.

Technical Specifications: Type 5 recoilless gun (nominal)

Diameter (outside): 89 mm (3.50 in)

Length (barrel): 1,100 mm (43.31 in)

Technical Specifications: Type 5 projectile

Diameter: 74 mm (2.91 in)

Length (overall): 693 mm (27.28 in)

Length (warhead): 336 mm (13.23 in)

Length (motor and fins): 357 mm (14.06 in)

Functional type: Chemical

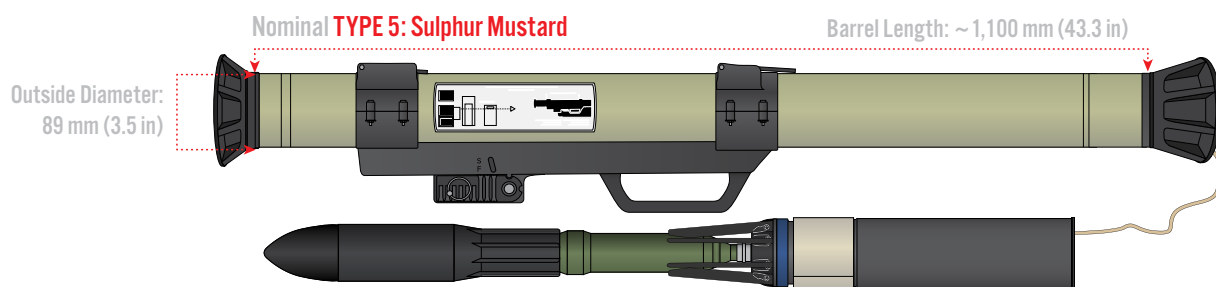


Figure 5.10 A proposed configuration of the nominal Type 5 (sulphur mustard) IS light recoilless gun and its Type 5 munition (source: ARES).

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