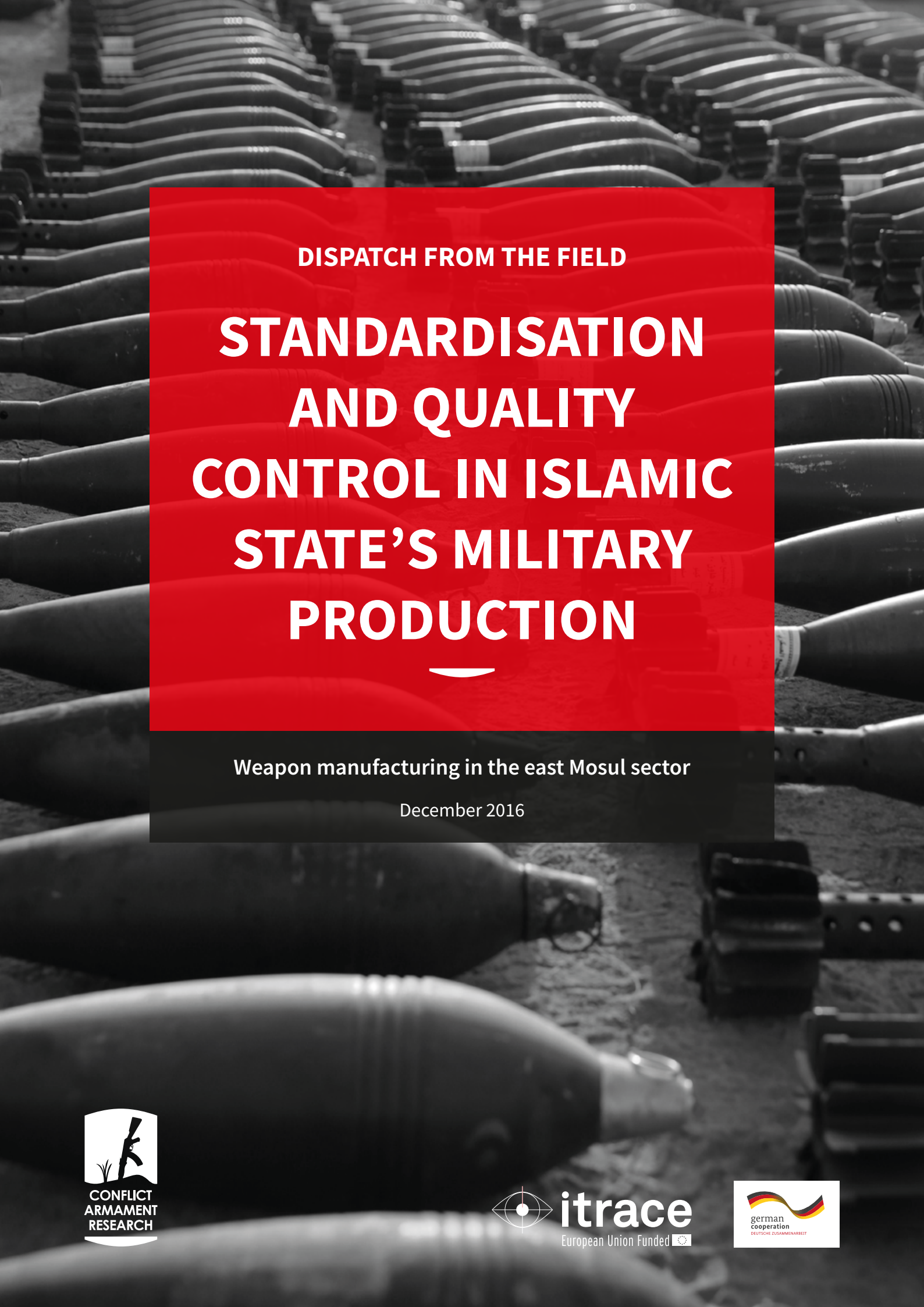

DISPATCH FROM THE FIELD

STANDARDISATION AND QUALITY CONTROL IN ISLAMIC STATE'S MILITARY PRODUCTION

Weapon manufacturing in the east Mosul sector

December 2016

CONFLICT ARMAMENT RESEARCH

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Islamic State rockets, Gogjali, Mosul, November 2016

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Cover Image: 120 mm mortar rounds, manufactured by Islamic State forces, recovered by Iraqi security forces near Mosul, in October and November 2016.

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INTRODUCTION

From 11 to 16 November 2016, a Conflict Armament Research (CAR) field investigation team embedded with Iraqi armed forces during the initial phases of the assault on Islamic State (IS) forces in eastern Mosul. The team's objective was to gather, first-hand, all available information on weapons and ammunition recovered from IS forces on the battlefield. During its deployment, the team gained unprecedented access to six weapon manufacturing facilities once operated by IS forces, recorded extensive documentary evidence of centrally managed weapon production, and documented a wide range of IS-manufactured ordnance recovered during ground combat operations. CAR deployed a second team on 18 November 2016, whose work in Mosul continued at the time of writing.

This Dispatch from the Field presents findings on the structure and output of IS forces' weapon production in the eastern Mosul sector. While previous CAR reports used the term 'quasi-industrial production,' the phrase does not reflect the scale and sophistication of manufacturing encountered by CAR in Mosul. Although production facilities employ a range of non-standard materials and chemical explosive precursors, the degree of organisation, quality control, and inventory management, indicates a complex, centrally controlled industrial production system.

Iraqi Army 9th Division convoy near Mosul, 14 November 2016

Rocket components, Gogjali

In this system, multiple manufacturing facilities work to produce weapons according to precise technical guidelines issued by a central authority. The production of any one weapon system involves the coordinated input of numerous facilities at different stages of the production cycle: from the processing of raw materials, to the mixing of chemical explosive precursors, to machining, assembly, and final sign-off by dedicated quality control personnel.

To function, this production line requires a sophisticated monitoring system, in which manufacturing facilities regularly report detailed figures on production rates and the quality of output to a central procurement and production authority—all of which are critical to forecasting material requirements and to ensuring that all manufactured weapons conform to standard specifications.

Standardisation serves critical battlefield requirements. The directives issued by IS forces to production facilities seek to minimise the variation among weapons and ammunition manufactured by a multitude of often-distant factories and workshops. This enables weapon interoperability, which means that mortar rounds manufactured in one part of IS forces' territory are calibrated to fit mortar tubes produced in facilities located elsewhere.

Consistency in production also requires consistency in the supply of materials used to manufacture weapons and ammunition. IS forces have demonstrated repeatedly that, to ensure all weapon systems function identically, they must be constructed from the same materials. This is particularly so of chemical precursors used to manufacture explosives and propellant.

IS-manufactured 120 mm mortar rounds, near Karamlais

WHILE PREVIOUS CAR REPORTS USED THE TERM 'QUASI-INDUSTRIAL PRODUCTION,' THE PHRASE DOES NOT REFLECT THE SCALE AND SOPHISTICATION OF MANUFACTURING ENCOUNTERED BY CAR IN MOSUL.

IS mortar production facility, Gogjali

PRODUCTION DATES SPANNING A RANGE OF YEARS, SUGGEST THAT IS FORCES HAVE MADE REPEATED ACQUISITIONS OF IDENTICAL PRODUCTS FROM THE SAME SOURCES—ALMOST EXCLUSIVELY FROM THE TURKISH DOMESTIC MARKET.

Evidence documented by CAR during 29 months of operations along IS frontlines indicates that IS forces have made one-off, bulk-procurements of chemical precursors from single suppliers. In other cases, production dates spanning a range of years suggest that IS forces have made repeated acquisitions of identical products from the same sources—almost exclusively from the Turkish domestic market. These findings indicate the mass diversion of chemical precursors and a robust supply chain extending from Turkey, through Syria, to Mosul.

The supply of homogenous raw material clearly assists IS forces in the production of uniform weapon systems. Documents issued by IS forces, and CAR's physical examination of IS-produced weapons, underscore this. The group's Central Organisation for Standardisation and Quality Control (COSQC) issues blueprints for weapon construction, which provide standard parameters for the manufacture of mortars, mortar rounds, and rockets—in addition to the precise chemical mixes of explosives and propellant—using products of a specific type and origin. CAR's examination of weapons found whilst under construction, in addition to those deployed with IS forces and recovered on the battlefield, confirm that production output conforms to these standards—usually to the tenth of a millimetre.

The functioning of this quality control system—illustrated by a stream of written directives and periodic reporting, documented by CAR—provides deep insights into IS forces' broader command and control systems. The group is highly bureaucratic, adheres to strict reporting lines, and operates a series of monitoring and evaluation mechanisms. These are evident, not only in periodic reporting by individual units on weapon production, but also in regular updates sent to central authorities on rations, ammunition expenditure rates, weapon holdings by serial number, and the health of fighters. This level of bureaucracy is not restricted to the Mosul area. CAR documented weekly workshop schedules and associated documents issued by the Committee for Military Development and Production (CMDP) in production facilities during its June 2016 investigations in Fallujah.[1]

Documentary evidence recorded by CAR also proves IS forces provide fighters with sophisticated instruction on improvised explosive device (IED) construction, emplacement, and on the operation of complex weapon systems such as anti-tank guided weapons. These are not short courses, but structured lessons—evidenced by the numerous examination papers submitted by IS students and documented by CAR across the eastern Mosul sector.

Whilst technical in nature, these findings must also be viewed within the framework of IS forces' political aspirations—notably efforts by the group to instil confidence among its fighters in its capacity as a 'state' administration. The uniform painting, labelling, and branding of weapons and ammunition is a critical element. Although these measures, such as defining the calibre and date of production, clearly benefit weapon management—notably accounting—they also speak to IS forces' attempts to mirror the functions of a national military force. These factors arguably legitimise the group's capacity and coherence in the eyes of IS fighters as much as they serve clear logistical functions.

KEY FINDINGS

STANDARDISED WEAPON PRODUCTION

IS forces operate a 'Central Organisation for Standardisation and Quality Control' (COSQC), which falls under the authority of the group's 'Soldiers' Bureau, Committee for Military Development and Production.' The COSQC issues specific guidelines on weapon production parameters and controls manufacturing quality.

PRODUCTION TO MILITARY STANDARDS

IS forces adopt similar practices to national military forces, which distinguish the group from other groups that manufacture improvised weapons on an *ad hoc* basis. The production of factory grade packaging is one example, whereby the group has constructed palletised wooden boxes for the long-term storage, and long-range transport, of rockets and mortar rounds.

SPECIALISATION

IS forces operate a wide range of specialised manufacturing plants. Although these facilities may be distant from one another, they are centrally coordinated, produce to pre-defined standards, and manufacture separate stages of weapon production.

QUANTITIES

Within a six-day period, CAR investigators documented more than 5,000 rockets and mortar rounds in various stages of production. CAR also documented more than 500 finished mortar rounds, which Iraqi forces had recovered on the battlefield. These findings suggest that overall production by IS forces in the months leading up to the Mosul offensive runs into the tens of thousands.

Qaraqosh, Iraq, November 2016

RAPID PRODUCTION

Labels affixed to the mortar rounds produced by IS forces, and documented by CAR in the eastern Mosul sector in early November 2016, show that most were manufactured in October 2016, when Iraqi and Peshmerga forces had already begun the battle to liberate Mosul. These findings indicate very rapid supply to IS forces, and reinforce CAR's assertions that the total number of rockets and mortars produced must run into the tens of thousands.

MASS DIVERSION OF COMMERCIAL GOODS

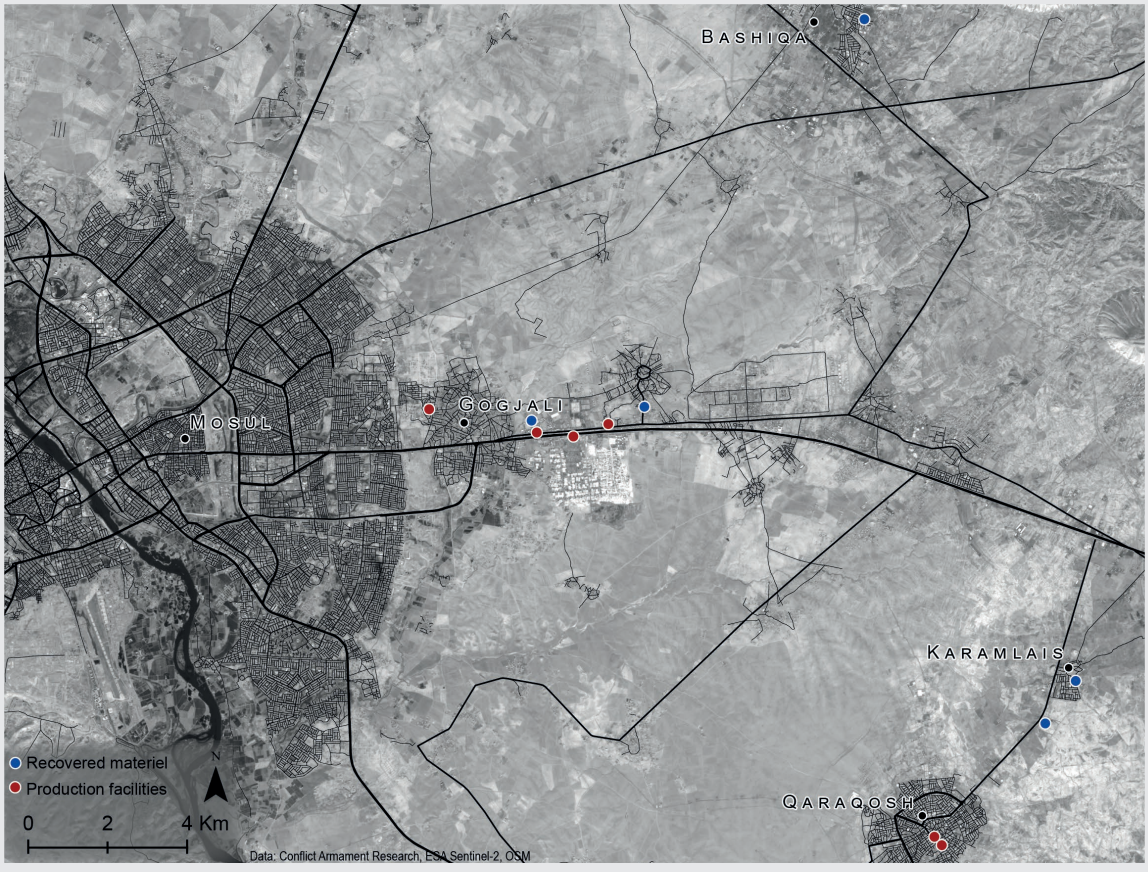
CAR documented large quantities of chemical precursors used by IS forces in the production of rocket propellant. Many of these precursors are either manufactured by the same factory, or supplied by the same distributor. IS forces procured them in bulk and sometimes at the same time. Such bulk buying from single sources is likely to be highly visible in commercial sales records.

ROBUST SUPPLY CHAIN

CAR documented other components that, while procured from the same source by IS forces, had been procured on different dates, in large quantities, and over a long period of time. This indicates that IS forces have a robust supply chain, whereby the group can repeatedly procure chemicals from the same supplier—almost exclusively from the Turkish domestic market.

TURKISH ORIGIN

IS forces source most of the products used in the manufacture of weapons and ammunition from the Turkish domestic market. CAR's findings continuously reinforce evidence that the group operates a major acquisition network in Turkey and has a direct line of supply from Turkey, through Syria, to the Mosul area.



IS production facilities and recovered materiel locations in the eastern Mosul sector

DOCUMENTED MATERIEL

Between 11 and 16 November 2016, a CAR field investigation team documented six weapon-manufacturing facilities, operated by IS forces, located in the Gogjali and Qaraqosh districts, which lie to the east of Mosul.

The facilities produced a diverse range of products, including cast mortar round casings, rocket components, explosives, and propellant. As indicated in the map above, these facilities are situated in numerous locations. They range in size from relatively large (circa 10,000 m^2) foundries used to produce mortar round casings, to small (circa 30 m^2) workshops used to machine rocket components and prepare explosives. Although these facilities are numerous and dispersed, CAR's detailed measurement of weapons produced on site, combined with production specifications and quality management documents recovered by CAR, indicate that IS forces manufacture to pre-defined standards. These standards ensure that all produced weapons operate similarly—in the same way that a national army would ensure weapon and ammunition interoperability across its forces.

The following sections of this report provide CAR's findings from the facilities, including production processes, the sourcing of raw materials and chemical precursors, and IS forces' inventory management and quality control systems.

While this Dispatch references a wide range of technical documents issued by IS forces, CAR has elected to withhold some technical information from the public domain—particularly detailed information on explosive and propellant formulae and tactical doctrine documented at the sites.

IS-manufactured rockets, Gogjali, November 2016

MORTARS

PRODUCTION PROCESS AND ORGANISATION

IS forces' production of mortar rounds and mortar tubes is centrally controlled, with different phases of the production cycle occurring at a number of specialised facilities. These facilities perform dedicated tasks in the manufacture of mortar rounds, including metal forging, machining, explosive filling, and the production of tubes. At the completion of a production stage, IS forces relocate the unfinished item to another facility, where the production cycle continues. CAR previously observed this division of labour during investigations in IS forces' weapon-manufacturing facilities in Fallujah, in June 2016.[2]

MORTAR TUBES

IS forces modify factory produced steel pipes to construct mortar tubes. These pipes need to withstand the pressures generated by firing a 120 mm projectile, which would normally be in the region of 14,000-14,500 psi.[3] Measurements made by CAR indicate that the pipes have an outside diameter of approximately 149 mm and an inside diameter of 119.5 mm.[4] Although not confirmed at this stage in CAR's investigations, oil drill pipe with an outside diameter of 5 7/8 inches (149.225 mm) is a plausible source of the tubes.

Oil industry documentation confirms that pipes of this diameter are able to withstand operating pressures exceeding 15,000 psi, with collapse pressures of around 17,000 psi.[5] If the mortars are built with drill pipes, the tubes would be able to withstand multiple firings. Some of the tubes documented by CAR—which are of various calibres, including 81 mm, 119.5 mm, and 220 mm—are threaded close to the muzzle, which may provide further indication that they are constructed using drill pipe. All mortar tubes documented by CAR feature threaded caps, which are used to seal the breach of the mortar.

Image 1

120 mm mortar tube manufactured by IS forces
Near Karamlais, November 2016

Image 2

A mortar production facility
Gogjali, Mosul, November 2016

CAR DOCUMENTED NUMEROUS 120 MM MORTAR ROUNDS ACROSS THE EASTERN MOSUL SECTOR, INCLUDING AT PRODUCTION FACILITIES AND FOLLOWING BATTLEFIELD RECOVERY.

MORTAR ROUNDS

IS forces in the Mosul sector produce what they describe as 120 mm mortar rounds. Measurements taken by CAR, and notes applied by IS forces to labels, indicate that the rounds are 119 mm in calibre. This is a non-standard calibre, which IS forces appear to have adopted because the high-grade steel pipes, which they use to construct mortar tubes, happen to have an internal diameter that is slightly larger than 119 mm (for ease of reference the following text describes the rounds as 120 mm in calibre).

CAR documented numerous such 120 mm mortar rounds across the eastern Mosul sector, including at production facilities and following battlefield recovery. The number of finished rounds documented by CAR exceeds 500. The labels on the rounds indicate that IS forces manufactured most of them in October 2016.

Additionally, CAR documented more than 5,000 mortar rounds in various stages of manufacture. The scale of recent production—which continued during the offensive by Iraqi forces in the districts concerned—suggests that IS forces have probably manufactured tens of thousands of rounds. The group currently deploys many of them in service on frontline positions.

Image 3

120 mm mortars round manufactured by IS forces
Gogjali, Mosul, November 2016

Details

Length (with fuse): 570 mm
Diameter: 119 mm
Number of fins: 12
Number of gas-check bands: 4
Distance between gas-check bands: 5 mm
Fuse type: Point detonating, with safety pin
Fuse length (visible): 45 mm
Fuse diameter: 46 mm
Weight: 12-13 kg

Image 4

Scrap metal near an ordnance production facility
Gogjali, Mosul, November 2016

The production of mortar rounds does not require the high-grade steel necessary for the manufacture of mortar tubes, which need to withstand repeated high firing pressures. IS forces obtain the steel by melting scrap metal. The two foundries documented by CAR in Gogjali are located next to large scrap metal yards. IS forces recover the higher-grade steel components from these yards by cutting car engine block components into small pieces and melting them in improvised furnaces.

CAR documented five such furnaces (see step 4 of the casting process on the next page) of identical design in the two Gogjali production facilities.

IS mortar production facility, Gogjali, Mosul

The casting process is as follows:

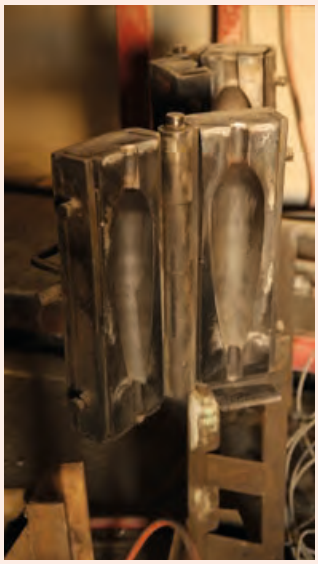
1

Creation of the mould by packing sand and cement into a wooden matrix…

… which is placed on top of a metal pattern. The pattern defines the external form of the mortar round.

2

Creation of moulded sand and cement cores, using a hinged mould in the form of the mortar round's internal cavity.



A steel rod is placed at the centre of the cores to enable later removal from the body of the finished mortar round casing.

3

Placement of the core between two, symmetrical sand and cement moulds.

4

Melting of scrap steel in an improvised furnace.

5

Pouring of molten steel into the mould.

6

Removal of the cast mortar round from the mould and removal of the core by pulling the steel rod at its centre to disintegrate the sand and cement.

All images Gogjali, Mosul, November 2016

Once cast, the empty mortar rounds are transferred to another workshop and machined to a uniform diameter. This process also includes the machining of gas-check bands (Image 5), and threading to accommodate fuses (at the nose) and fin assemblies (at the base).

Image 5

Gas-check bands on a 120 mm mortar round manufactured by IS forces
Gogjali, Mosul, November 2016

The fin assemblies are constructed of sheet metal, bent and welded to a steel tube (Image 6).

Image 6

A 120 mm mortar round fin assembly manufactured by IS forces
Gogjali, Mosul, November 2016

The fuse bodies are of cast aluminium, which is milled and threaded (Image 7).

Image 7

A point-detonating fuse for a 120 mm mortar round manufactured by IS forces
Gogjali, Mosul, November 2016

Once machined, the mortar rounds are moved to a dedicated explosive filling facility. When filled, the mortar rounds are painted an olive-green colour, which is identical in colour to the paint applied to rockets documented by CAR in Gogjali. The rounds are then labelled with quality control information (see below).

Increment charges and ignition cartridges accompanied some 120 mm mortars documented by CAR. The increment charges are manufactured from white muslin cloth, which is stitched to form a tube, filled with propellant, and tied at both ends.

Image 8

Bagged increment charges manufactured by IS forces
Gogjali, Mosul, November 2016

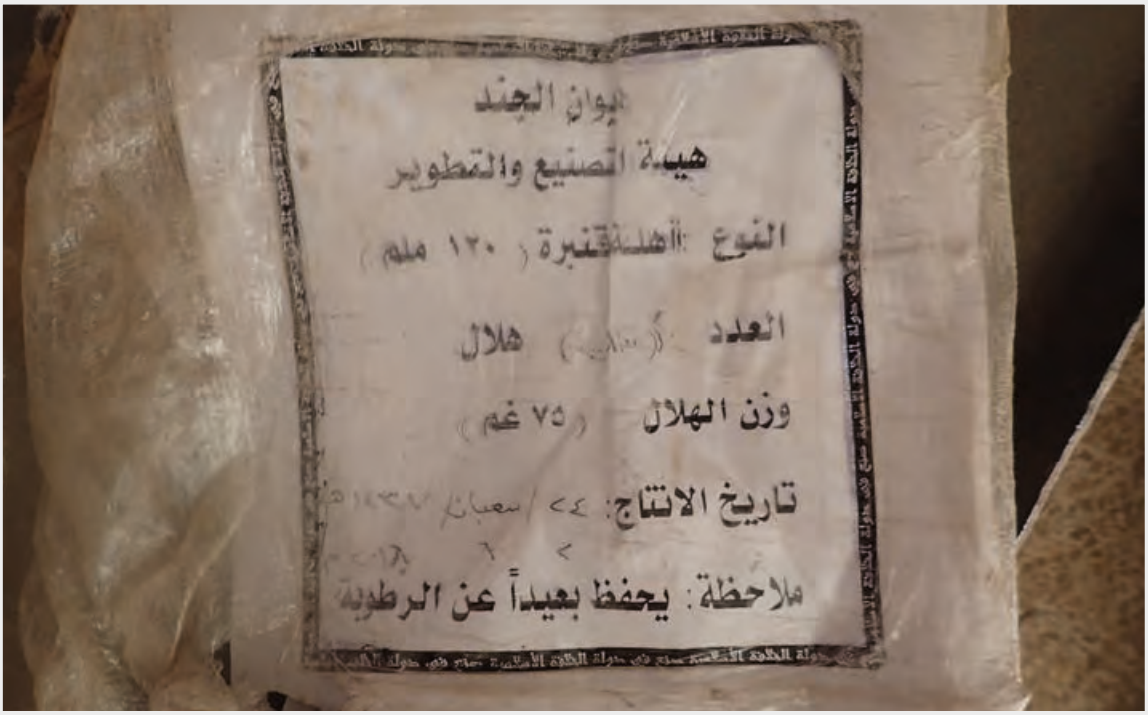


Image 9

Label from an increment charge box manufactured by IS forces
Gogjali, Mosul, November 2016

Translated details
Soldiers' Bureau
Committee for Military Development and Production
Type: Increment charges mortar 120 mm
Quantity: 80
Weight: 75 grams
Date of production: 24 Shaban 1437 2/6/2016
Please keep dry

IS forces employ modified 12-gauge shotgun rounds as mortar ignition cartridges. The rounds have been cut, the shot removed, and the cut aperture sealed with a cardboard disk. 25 are packed into a cardboard box, which is labelled to indicate that the cartridges are to be used in 120 mm mortar rounds. The labels also note the 'production' date (Image 10).

Image 10

Label and package for modified 12-gauge ignition charges for 120 mm mortar rounds
Gogjali, Mosul, November 2016

IS forces also produce combined mortar ignition and propelling cartridges (Image 11). These are approximately 150 mm in length (lengths vary fractionally) and comprise a cardboard tube housing the propellant and an aluminium cap and primer. They are packed in a box and labelled.

Image 11

Combined ignition and propelling cartridge for 120 mm mortar rounds manufactured by IS forces

Gogjali, Mosul, November 2016

CAR documented a number of point-detonating fuses, which it observed in several weapon production facilities, or screwed to mortar rounds across the eastern Mosul sector (Image 12). These are constructed from cast aluminium (which is sometimes machined) and feature a blunt nose connected to a firing pin. When struck, the firing pin strikes a plain detonator, which protrudes from the base of the fuse. The detonator is wrapped in detonating cord and pushed into the explosive fill within the mortar bomb.[6]

Image 12

Point-detonating fuses with safety pins and plain detonators for mortar rounds manufactured by IS forces

Gogjali, Mosul, November 2016

Iraqi Army 9th Division firing base near Mosul

On 22 November 2016, a second CAR field investigation team documented boxes for 120 mm mortars (Image 13). The boxes are manufactured from factory-finished timber and are palletised to allow for the free circulation of air when stacked and for ease of lifting.

These features suggest that the packaging is designed both to protect the rounds during transportation over long distances and to ensure that they are protected from environmental damage (primarily heat) when stored for long periods of time.

Image 13

Palletised, wooden boxes for 120 mortar rounds manufactured by IS forces
Near Karamlais, November 2016

SUMMARY

IS forces operate a complete production process for manufacturing mortar tubes and mortar rounds. Although some of these processes require the acquisition of factory manufactured chemical precursors and industrial pipes, IS forces perform most of the production processes needed to manufacture mortar rounds, explosive filling, increment charges, and ignition cartridges. CAR estimates recent production of mortar rounds to be in the tens of thousands.

ROCKETS

PRODUCTION PROCESS AND ORGANISATION

As with the manufacture of mortars, CAR documented a range of facilities that perform different stages of the rocket production process. IS forces in the eastern Mosul sector manufacture two primary types of rocket: 1) a short rocket measuring 110 mm in diameter, with an un-fused overall length of 750 mm; and 2) a long rocket measuring 115 mm in diameter, with an un-fused overall length of 1,750 mm. IS forces' documents recovered by CAR refer to the latter rocket as a '*Fateh*.'

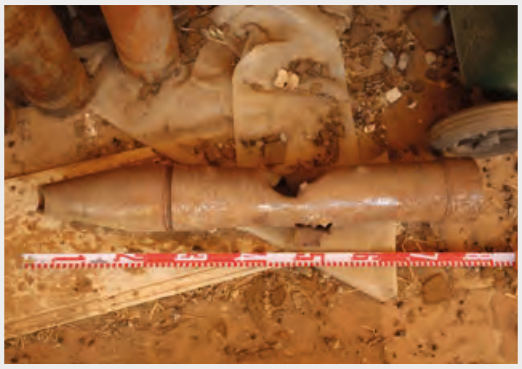


Image 14

110 mm rocket manufactured by IS forces
Qaraqosh, November 2016

Dimensions
Warhead: 200 mm
Body: 500 mm
Base length: 50 mm
Diameter: 110 mm

Image 15

***Fateh* 115 mm rocket manufactured by IS forces**
Gogjali district, Mosul, November 2016

Dimensions
Warhead: 380 mm
Body: 1,200 mm
Exhaust assembly: 170 mm
Fin assembly: 165 mm
Diameter: 115 mm

The shorter rocket is launched from a rectangular frame that holds eight rockets. The longer rocket is launched singly from an adjustable, angled rail (Image 17 next page).

Image 16

Adjustable, angled launch rail manufactured by IS forces
Near Karamlais, November 2016

Image 17

110 mm rocket launch frame (eight rockets) manufactured by IS forces
Qaraqosh, November 2016

The production process required to manufacture these two types of rocket is divided into the following stages:

The machining of 110 mm and 115 mm steel pipe, which is threaded to accommodate a warhead at one end and an exhaust at the other.

Image 18

Main pipe
Qaraqosh, November 2016

The machining of the base differs for the two rocket types. The short rocket exhausts feature six angled nozzles drilled through a circular block of steel (Image 19).

Image 19

Short rocket exhausts
Qaraqosh, November 2016

Dimensions
Nozzle aperture: 25 mm
Exhaust diameter: 110 mm

The long rockets feature a cone-shaped nozzle (Image 20).

Image 20

115 mm rocket nozzle
Qaraqosh, November 2016

Image 21

115 mm rocket base, inside view
Qaraqosh, November 2016

The welding and threading of the stabiliser fin assemblies, which are screwed onto the base of the long rockets, around the nozzle (the short rockets do not feature stabilisation fins).

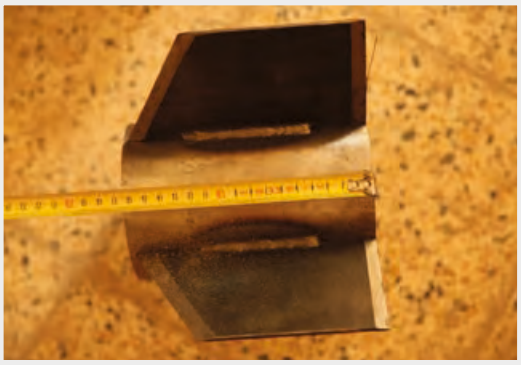


Image 22
Stabiliser fin
Gogjali, Mosul, November 2016

The machining of warhead sections, which are threaded to accommodate the tubular rocket body and a fuse at the nose.

Image 23
Warhead
Qaraqosh, November 2016

Church in Qaraqosh, Iraq, November 2016

IS forces have constructed a range of point-detonating fuses for use in rockets. CAR documented machined aluminium fuses of various dimensions (Image 24) and plastic fuses of similar design (Image 25). The fuses are all threaded for attachment to the nose of the rocket warhead and follow the same basic design: a sprung firing pin is housed in the nose of the fuse. When impacted, the firing pin strikes a plain detonator, the base of which protrudes from the threaded end of the fuse. When screwed to the warhead, the protruding detonator, which is wrapped in detonating cord, is pushed into the explosive fill.

Image 24

Two different types of point-detonating fuse (pictured without plain detonators attached) observed in a workshop operated by IS forces
Qaraqosh, November 2016

Dimensions

Larger fuse:	**Smaller fuse:**
Length: 111 mm	**Length:** 66 mm
Diameter: 42.50 mm	**Diameter:** 33 mm

Image 25

Plastic point-detonating fuses, with plain detonators attached, manufactured by IS forces
Gogjali, Mosul, November 2016

After machining, IS forces move the empty rockets to a propellant-filling facility. Here, the rockets are filled with a propellant mix (see below), which is packed into the rocket body using, first, a hydraulic ram (Image 26) and then by prolonged pressure using vertical presses and rams (Image 27).

Image 26

Hydraulic ram
Gogjali, Mosul, November 2016

Image 27

Vertical presses and rams
Gogjali, Mosul, November 2016

Following the addition of the propellant, the rockets are painted—using a standard olive-green paint, which is identical in colour to all rockets and mortar rounds documented by CAR—and boxed or wrapped in plastic for onward shipment to an explosive-filling facility.

IS ROCKET PRODUCTION OCCURS AT A NUMBER OF SPECIALISED FACILITIES.

Image 28
Repackaged olive-green paint
Gogjali, Mosul, November 2016

Image 29
Painting room
Gogjali, Mosul, November 2016

Image 30
Semi-painted *Fateh* rockets
Gogjali, Mosul, November 2016

Image 31
Painted and packaged 110 mm rockets manufactured by IS forces
Gogjali, Mosul, November 2016

Examination of the boxes reveals that IS forces have taken particular care to construct them according to common military practice. Similar to the boxes constructed by IS forces for mortar rounds, the boxes are built to a high standard, suitable for transportation over long distances, and palletised for the long-term storage of rockets.

Evidence documented by CAR indicates that explosive filling occurs at another (undocumented) location. In the case of the rockets illustrated (Image 30), IS forces had loaded the propellant and painted the rockets, but the warheads remained unfilled. CAR's findings suggest that two unfinished rockets are loaded into each of the boxes (Image 32) before onward transportation to a filling facility.

Image 32

Empty boxes for 115 mm *Fateh* rockets manufactured by IS forces
Gogjali, Mosul, November 2016

Crate dimensions
1875 x 255 x 285 mm

CAR documented numerous electrical initiators, which IS forces use to fire rockets of various types. The initiators are identical and constructed using white muslin cloth—matching the cloth used in mortar increment charges—filled with powder (composition unknown) and initiated by an electrical current passed between two wires (Image 33).

SUMMARY

IS rocket production occurs at a number of specialised facilities. The quality of machining is uniformly to a high standard and the group has taken great lengths to ensure that its finished products resemble military grade materiel. This is evident in a number of ways that are not immediately necessary to operate the weapons, including: painting the rockets a uniform green colour and the production of boxes, which would easily conform to national military specifications.

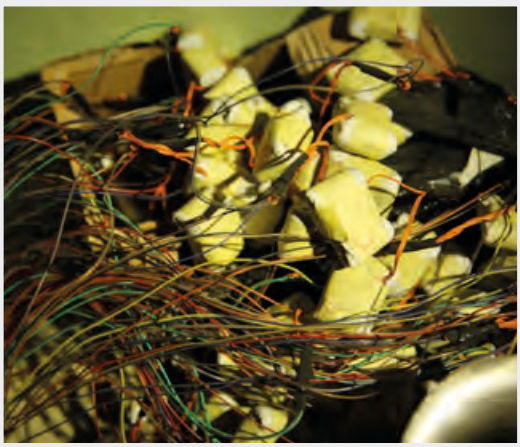


Image 33

Electrically-operated initiators manufactured by IS forces
Gogjali, Mosul, November 2016

COMPONENT SOURCING

CHEMICAL PRECURSORS AND ANCILLARY PRODUCTS

CAR documented a number of different chemical precursors and ancillary products used by IS forces to produce rocket propellant and the explosive filling for mortar rounds and rocket warheads.

CAR has contacted the manufacturers and distributors identified below. Investigations into the products' full chains of custody are ongoing, and CAR does not in any respect imply direct transfer of goods to IS forces by the companies mentioned in this report.

Table 1
Types of products documented in the eastern Mosul sector

Type of product	Used in	Source
Potassium nitrate	Propellant	Latvia, Turkey
Sorbitol	Propellant	France
Sugar	Propellant	Lebanon, Turkey, UAE
Aluminium	Explosive fill	Turkey
Grease	Ordnance machining	Turkey
Cement	Mortar moulds and cores	Turkey

The field investigation team documented numerous bags of potassium nitrate, produced by the Belgian company SQM Europe, and sold through the Turkish distributor Doktor Tarsa. The team documented these bags in three IS forces' production facilities. Markings on the bags indicate production in 2014 (month not listed), and in April, May, and September 2015.

During investigations in Fallujah, in June 2016, CAR documented bags of potassium nitrate from the same source, produced in April 2015. In response to an information request sent by CAR in July 2016, the Turkish distributor Doktor Tarsa confirmed that the company sold the product on the Turkish domestic market.[7]

Image 34
A bag of potassium nitrate from the Turkish distributor Doktor Tarsa
Qaraqosh, November 2016

Image 35
A bag of potassium nitrate from the Turkish distributor Doktor Tarsa
Fallujah, June 2016

The presence of large quantities of potassium nitrate, procured over a long period of time and from a single source, and found in several production facilities in Iraq, indicates large-scale diversion from the Turkish domestic market.

Additionally, CAR documented bags of potassium nitrate distributed by the Latvian company Uralchem used by IS forces in the production of propellant

THE PRESENCE OF LARGE QUANTITIES OF POTASSIUM NITRATE PROCURED FROM A SINGLE SOURCE INDICATES LARGE-SCALE DIVERSION FROM THE TURKISH DOMESTIC MARKET.

Image 36

A bag of potassium nitrate manufactured by the Latvian company Uralchem
Fallujah, June 2016

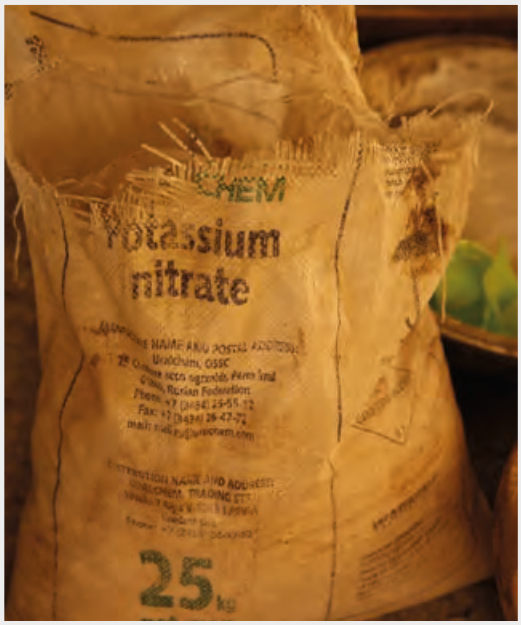


Image 37

A bag of potassium nitrate from the Latvian company Uralchem
Qaraqosh, November 2016

120 mm mortars manufactured by IS forces, near Karamlais, November 2016

CAR has previously documented Uralchem potassium nitrate in IS-operated workshops in Fallujah, during investigations in June 2016. In a response to an information request sent by CAR, the company indicated that the bag documented in Fallujah had been produced in 2010. In 2011, the company sold a limited quantity of this product to a Hong Kong-based company for onward sale to Syria (prior to any unrest in the region). The company reports no sales to Syria after 2011 and states that it does not export this product to Iraq. Uralchem last sold this type of product to Turkey (to a Turkish company that deals in water-soluble fertilizers) in early 2013.[8]

The presence of this product, made by the same company, shows that IS forces operate a robust distribution process, indicated by the supply of the same products to different weapon-manufacturing facilities across Iraq.

CAR also documented potassium nitrate produced in 2011 by the Turkish company Toros and used in the manufacture of rocket propellant by IS forces.

Image 38

A bag of potassium nitrate produced by the Turkish company Toros

Gogjali, Mosul, November 2016

Image 39

Approximately 100 25kg bags of Sorbitol manufactured by the French company Tereos

Gogjali, Mosul, November 2016

Image 40

A bag of Sorbitol manufactured by the French company Tereos

Gogjali, Mosul, November 2016

CAR also documented large quantities of Sorbitol at a number of different production facilities. Sorbitol is a sugar substitute that IS forces use in the production of propellant. The French company Tereos manufactured both of the documented items in 2015.

Such a large quantity of chemical precursor, originating from the same manufacturer, and produced at the same time, suggests large-scale diversion and a single supply source.

CAR also documented identical Sorbitol bags, with sequential batch numbers, distributed to IS weapon production facilities in Gogjali and Qaraqosh, which suggests centralised supply to workshops across the eastern Mosul sector.

CAR documented large quantities of sugar, which IS forces use in the production of propellant. The sugar originates from three factories: the Turkish company Türkiye Şeker Fabrikaları, manufactured on an unknown date (Image 41); the Lebanese company Chekka Sugar Refinery, manufactured in November 2015 (Image 42); and the Emirati company Al Khaleej Sugar, manufactured in September 2013 (Image 43).

During investigations in Fallujah, in June 2016, CAR also documented a bag of sugar produced by Al Khaleej Sugar in January 2015 and used by IS forces in the production of propellant. In response to an information request, Al Khaleej Sugar replied that it had sold the bag to the Ministry of Trade/ State Company for Foodstuff Trading, Baghdad, Iraq, under a December 2014 contract.[9]

Image 41

A bag of sugar manufactured by the Turkish company Türkiye Şeker Fabrikaları
Qaraqosh, November 2016

Image 42

A bag of sugar manufactured by the Lebanese company Chekka Sugar Refinery
Gogjali, Mosul, November 2016

Image 43

A bag of sugar manufactured by the Emirati company Al Khaleej Sugar
Gogjali, Mosul, November 2016

EXCEPT FOR LOCALLY AVAILABLE MATERIAL, SUCH AS STEEL, IS FORCES SOURCE MOST OF THE PRODUCTS USED TO MANUFACTURE EXPLOSIVE WEAPONS FROM TURKEY.

Although the facilities visited in and around Mosul seem to have been used by IS forces primarily in the production of propellant, CAR observed aluminium in one location. Aluminium is a chemical precursor used by IS forces to produce explosives. CAR documented a drum of aluminium paste produced by the Chinese company Hefei Sunrise Aluminium Pigments and distributed in Turkey. The batch observed in the Mosul area is part of a transaction dated September 2014.

The drum CAR documented near Mosul resembles other drums with very similar labels found previously in other areas. These drums had been distributed on the Turkish domestic market by Metkim Kimyevi Maddeler. CAR documented their use by IS forces during its April 2015 investigations in Tikrit and its June 2016 investigations in Fallujah. The batch numbers of these items indicated transactions dated October 2014[10] and January 2015, respectively.

Image 44

A drum of aluminium paste distributed in Turkey
Qaraqosh, November 2016

Image 45

A drum of aluminium paste distributed by the Turkish company Metkim
Fallujah, June 2016

Mortar production facility, Gogjali, Mosul, November 2016

In addition to products that have direct applications in the preparation of explosive or propellants, CAR also documented a number of ancillary products used in IS production facilities.

Drums of grease, which IS forces use to lubricate machines and facilitate the threading of rocket components, are uniformly of a type produced by the Turkish company Petrol Ofisi, in September 2015. The month of manufacture also matches the production months of batches of Turkish potassium nitrate documented by CAR across the eastern Mosul sector (see above). These findings indicate that IS procured a range of items that were critical to its weapon production around the same time and possibly through the same supply route.

Image 46
Grease produced by the Turkish company Petrol Ofisi
Gogjali, Mosul, November 2016

Image 47
Detail of grease packaging produced by the Turkish company Petrol Ofisi
Gogjali, Mosul, November 2016

CAR also observed large quantities of cement used by IS forces to make moulds and cores for the production of mortar round casings. The Turkish company Canbensan produced all the cement documented. No date of manufacture is visible on the packaging.

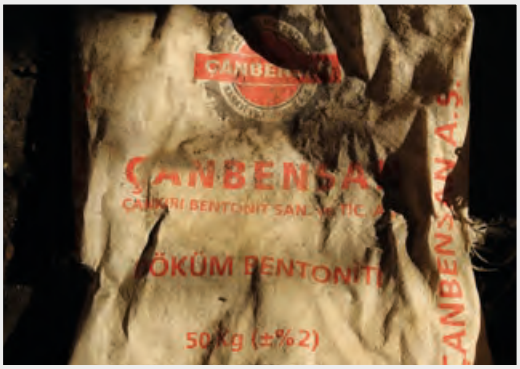


Image 48
Cement produced by the Turkish company Canbensan
Gogjali, Mosul, November 2016

SUMMARY

A CAR investigation team in the east Mosul sector discovered large quantities of chemical precursors used by IS forces in the production of propellant. Data on the packaging, and information previously obtained by CAR from companies, indicate that IS forces procured many of these precursors in the same time periods. This is a firm indication of bulk diversion through single intermediaries.

Except for locally available material, such as steel, IS forces source most of the products used to manufacture explosive weapons from Turkey. These findings indicate that the group has, first, a major acquisition network operating in Turkey and, second, a clear supply route from Turkey, through Syria, to Iraq.

CAR's investigations also indicate IS forces acquired the same product types, produced or distributed by the same parties, over long periods of time. This indicates repeated procurement from the same supply sources, equating to a robust supply and distribution system.

QUALITY CONTROL, INVENTORY MANAGEMENT, AND PRODUCTION FORECASTING

STANDARDISED PRODUCTION AND QUALITY CONTROL

Documents recovered by CAR indicate that IS forces issue guidelines to ensure standardised weapon production. These guidelines address weights and measures in precise detail, in addition to defining quality control processes.

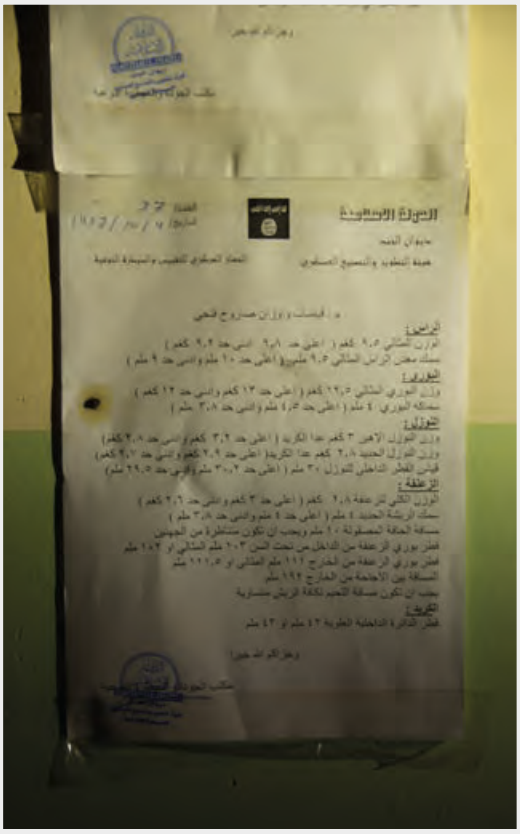


Image 49

Technical manual issued by the COSQC for 115 mm *Fateh* rockets

Gogjali, Mosul, November 2016

Image 49 presents a technical manual issued by the COSQC dated 9 July 2016 and observed by CAR on 12 November 2016 in Mosul. It provides precise specifications for the manufacture of a *Fateh* rocket, which is one of the 115 mm rockets pictured (Image 15 on page 18):

- Warhead weight of 9.5 kg (acceptable range between 9.2 and 9.8 kg)
- Warhead wall thickness of 9.5 mm (acceptable range between 9 and 10 mm)
- Rocket body weight of 12.5 kg (acceptable range between 12 and 13 kg)
- Rocket body wall thickness of 4 mm (acceptable range between 3.8 and 4.8 mm)
- Exhaust assembly weight of 3 kg (acceptable range between 2.8 and 3.2 kg)
- Exhaust base diameter of 30 mm
- Fins assembly weight of 2.8 kg (acceptable range between 2.6 and 3.0 kg)
- Fin acceptable thickness between 3.8 and 4 mm
- Distance between the fins and the base of the rocket of 10 mm
- Inside diameter of the fin assembly tube between 102 and 103 mm
- Outside diameter of the fin assembly tube between 111 and 111.5 mm
- Distance between the fins of 192 mm

These measures conform exactly to measurements taken by CAR of 115 mm *Fateh* rockets on 12 November 2016 in Gogjali.

Image 50

COSQC memorandum for quality control
Gogjali, Mosul, November 2016

IS forces maintain quality control personnel in each weapon-manufacturing facility. This ensures that all production conforms to the standards listed above. Image 50 presents a memorandum issued by the COSQC to all IS forces' production facilities, and dated 31 August 2016. It instructs all facilities to produce only to standards issued by the COSQC. The memorandum also specifies that quality control personnel assigned by the COSQC to the production facility must affix coloured, pre-printed labels to completed items, specifying that weights and measures conform to standards.

Image 51 and Image 52 illustrate that, although pre-printed, the labels provide a space for quality control personnel to enter the weight, the actual (rather than printed) calibre, and the date of production for the finished product.

Image 51

Labels on 120 mm mortar rounds manufactured by IS forces
Gogjali, Mosul, November 2016

Image 52

Label on a 120 mm mortar round, manufactured by IS forces
Gogjali, Mosul, November 2016

Label, type 1

Area of production	Type of ordnance
Date of production	Weight
	Calibre

Image 53

Label on 120 mm mortar round fin assembly manufactured by IS forces
Near Karamlais, November 2016

Label, type 2

Area of production	Overseeing authority
	Type of ordnance
Date of production	Weight
	Calibre

Image 54

Label on a box of ignition cartridges for 120 mm mortar rounds
Gogjali, Mosul, November 2016

Soldiers' Bureau/Committee for Military Development and Production/Explosives Division Cartridges
Mortar bomb 120 mm
Quantity: 25 cartridges
Please keep dry
Date of production

PRODUCTION FORECASTING

Image 55

Production record template
Gogjali, Mosul, November 2016

IS forces also maintain a central weapon production registry. CAR has recovered a number of production record templates from manufacturing facilities in the eastern Mosul sector. These documents (Image 55) list activities, including (from right to left): the day of the week (printed); the type of weapon manufactured; the quantity produced; the number produced but rejected by quality control; reasons for halted production; work place injuries sustained; and notes. The template concludes with a space for the name of the factory manager and the date.

CAR has already documented IS forces' detailed reporting on production totals.[11] However, in the eastern Mosul sector, CAR documented numerous printed templates of the type shown in image 55. These indicate standardised reporting to a central authority by multiple production facilities.

SUMMARY

IS forces operate a complex production management system, which includes issuing detailed standards to produce a variety of weapon systems. A quality management system ensures that each manufacturing facility operates in line with these standards. CAR's own measurements of the ordnance produced in these facilities confirm that IS forces adhere to those standards. The group also operates a detailed production reporting system, which enables central authorities to monitor the scale and quality of production, and forecast material requirements.

CONCLUSION

At the time of writing, in late November 2016, a coalition of forces faced intense resistance on the margins of Mosul as they attempted to defeat IS forces in the city. CAR's investigations among the recently liberated weapon and ammunition factories operated by IS forces reveal production on an unprecedented scale. Not only did CAR's investigation team document more than 5,000 items under construction, ranging from mortar rounds to rockets and explosives, the team also discovered many hundreds more on the field of battle. These weapons were in use at the time and comprised a critical component of IS forces' long-prepared defence of the city.

This Dispatch provides stark evidence that weapon manufacturing on such a scale is the result of an extremely robust procurement network, which can source component parts—repeatedly in many cases—from suppliers, whose products IS forces have used consistently in the construction of explosive ordnance across Iraq. It also provides further evidence of a major supply network operated by IS forces, which extends across Syria into Turkey—with the vast majority of chemical precursors, in particular, originating from large distributors in the Turkish domestic market.

Such an extended procurement system is only one part of a complex system of industrial weapon production operated by IS forces. In many respects, this system mirrors the reporting structures that would be expected of a national military force. The group's sophisticated management of weapon production, monitoring and reporting to ensure that disparate factories produce to common standards, emphasis on weapon interoperability, and attention to detail—such as the factory grade packaging it employs to store and transport its weapons—attest to this capacity.

This Dispatch underlines the fact that highly organised groups, when presented with opportunities to exploit commercial markets to the fullest, can operate largely independently to produce a range of militarily effective weapons to great effect.

CAR'S INVESTIGATIONS AMONG THE RECENTLY LIBERATED WEAPON AND AMMUNITION FACTORIES OPERATED BY IS FORCES REVEAL PRODUCTION ON AN UNPRECEDENTED SCALE.

ACKNOWLEDGMENTS

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ENDNOTES

1 See Conflict Armament Research (2016).

2 Ibid.

3 See Kuo, Heath, and Boyer (2011).

4 Damage to the muzzles of some of the recovered weapons made it difficult to obtain a precise measurement using callipers. Repeated measuring of the 120 mm mortar tube indicated a variation of +/- 1 mm.

5 See Grant Prideco (2003).

6 Based on fuses manufactured by IS forces, documented by CAR, in April 2015, near Kirkuk.

7 On 11 July 2016, the Turkish company Doktor Tarsa Inc. responded promptly to a formal trace request issued by CAR on 8 July 2016. This response confirms that: 1) Doktor Tarsa Inc. does not export potassium nitrate to either Iraq or Syria; 2) Doktor Tarsa Inc. sold the bag of potassium nitrate with lot number 18472, which was the subject of CAR's request, on the Turkish domestic market; 3) all sales of potassium nitrate are submitted to the Turkish Ministry of Agriculture, and therefore the records documenting the sale of this item can be obtained from there; and 4) potassium nitrate that is intended for the Turkish domestic market is packaged differently to the potassium nitrate intended for export. On 27 July 2016, SQM Europe N.V., a partner of Doktor Tarsa Inc., stated that SQM Europe had not sold KNO3 (potassium nitrate) directly to Iraq in 2015 or 2016. SQM Europe N.V. further confirmed that the packaging of the item in CAR's trace request indicates that the item was specifically for the Turkish domestic market.

8 On 11 August, the company SIA URALCHEM Trading (Riga, Latvia) responded promptly to a formal trace request issued by CAR on 14 July 2016. This response confirms that: 1) SIA URALCHEM TRADING manufactured the 25 kg bag of potassium nitrate, subject to CAR's request, in 2010; 2) in 2011, SIA URALCHEM sold a limited quantity of this product to a Hong Kong-based company for onward sale to Syria (prior to any unrest in the region); 3) no sales were made to Syria after 2011 and SIA URALCHEM does not export this product to Iraq; 4) SIA URALCHEM last sold this type of product to Turkey (to a Turkish company that deals in water-soluble fertilizers) in early 2013; 5) currently, it only sells Monoammonium Phosphate (a product which cannot be used as a precursor to make explosives) to the Turkish market; 6) SIA URALCHEM confirmed that it usually sells its product to distributors and that checks are carried out to ensure that its products are sold to bona fide customers and; 7) it is impossible for SIA URALCHEM to limit the onward sale of its product once the item has passed to the buyer, as it does not have either the contractual instruments or practical means to enforce any such limits.

9 On 9 August, the company Al Khaleej Sugar located in the UAE responded promptly to a formal trace request issued by CAR on 13 July 2016. This response confirms that: 1) Al Khaleej Sugar manufactured the 50 kg bag of sugar with lot number SF0189, subject to CAR's trace request, in the UAE in January 2015. 2) Al Khaleej Sugar sold items in this lot to the Ministry of Trade (MOT)/State Company for Foodstuff Trading, Baghdad, Iraq, under contract number 745 of 30 December 2014; 3) Al Khaleej Sugar shipped the sugar on board the vessels MV ADVENTURER K (bills of lading dated 7 February 2015) and MV BASRAH (bills of lading dated 10 February 2015) to MOT, Um Qasr, Iraq. Al Khaleej Sugar included copies of the 'Certificate Independent Surveyor' and 'Inspection Certificate', issued by the inspection company Baltic Control Emirates LLC, in its response to CAR.

10 On 22 September 2015, the Turkish company Metkim Kimyevi Maddeler Ltd.Sti responded promptly to a formal tracing request issued by CAR on 25 August 2015. In its response, Metkim Kimyevi Maddeler Ltd.Sti confirmed that: 1) it trades raw materials to the domestic market only and does not export any of these products; and 2) the company could not identify the customer to which it sold material subject to CAR's trace request, because it does not register sales by lot number. On 23 October 2015, Metkim Kimyevi Maddeler Ltd.Sti responded to an additional communication from CAR, sent on 7 October 2015. In its response, Metkim Kimyevi Maddeler Ltd.Sti confirmed that the lot number (141010359) of the item in question indicated that it has been produced on 10 October 2014.

11 See Conflict Armament Research (2016).

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